



Workshop Manual Fox 2004 ➤

4 - Cyl. diesel engine

Engine ID	ASY							
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Edition 08.2010





List of Workshop Manual Repair Groups

Repair Group

- 00 - Technical data
- 10 - Cylinders, engine block, support, protector
- 13 - Crankshaft, pistons
- 15 - Cylinder head, valve control mechanism
- 17 - Lubrication system
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- 23 - Supply system - mechanical injection (diesel)
- 26 - Exhaust system
- 28 - Chamber pre-heating system

Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.



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00 – Technical data

1 Technical data

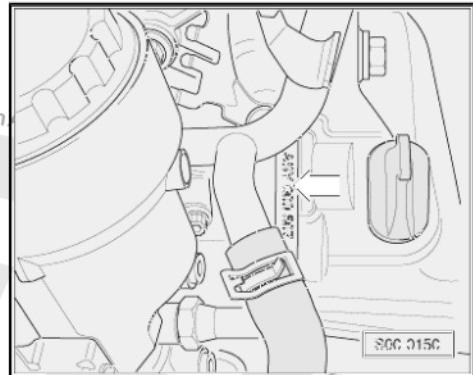
1.1 Engine number

Engine number ("engine identification letters" and "serial number") is engraved on the engine block, at the engine/transmission separation area.

The engine number has a maximum of nine (alphanumeric) digits. The first part (max. of three identification letters) represents the "engine identification letters"; the second part (six characters) represents the "serial number". If more than 999,999 engines with the same engine identification letters are produced, the first of the six digits is replaced by a letter.

Additionally, there is a sticker on the mechanical distribution upper cover with "the engine identification letters" and "the serial number".

The engine identification letters are also shown on the vehicle data plate.



1.2 Engine features

Engine identification letters	ASY
Production	.11.01 >
Cylinder volume	1896
According to the exhaust gas limit values	EU 3 Norm
Power	64,0(47,0)/4000
Torque	125,0(12,7)/1600
Diameter	79,5
Stroke	95,5
Compression rate	19,5:1
CZ	at least 49
Knock control	✓ knock sensor
Self-diagnosis	yes
Catalytic converter	yes
Exhaust gas return	yes

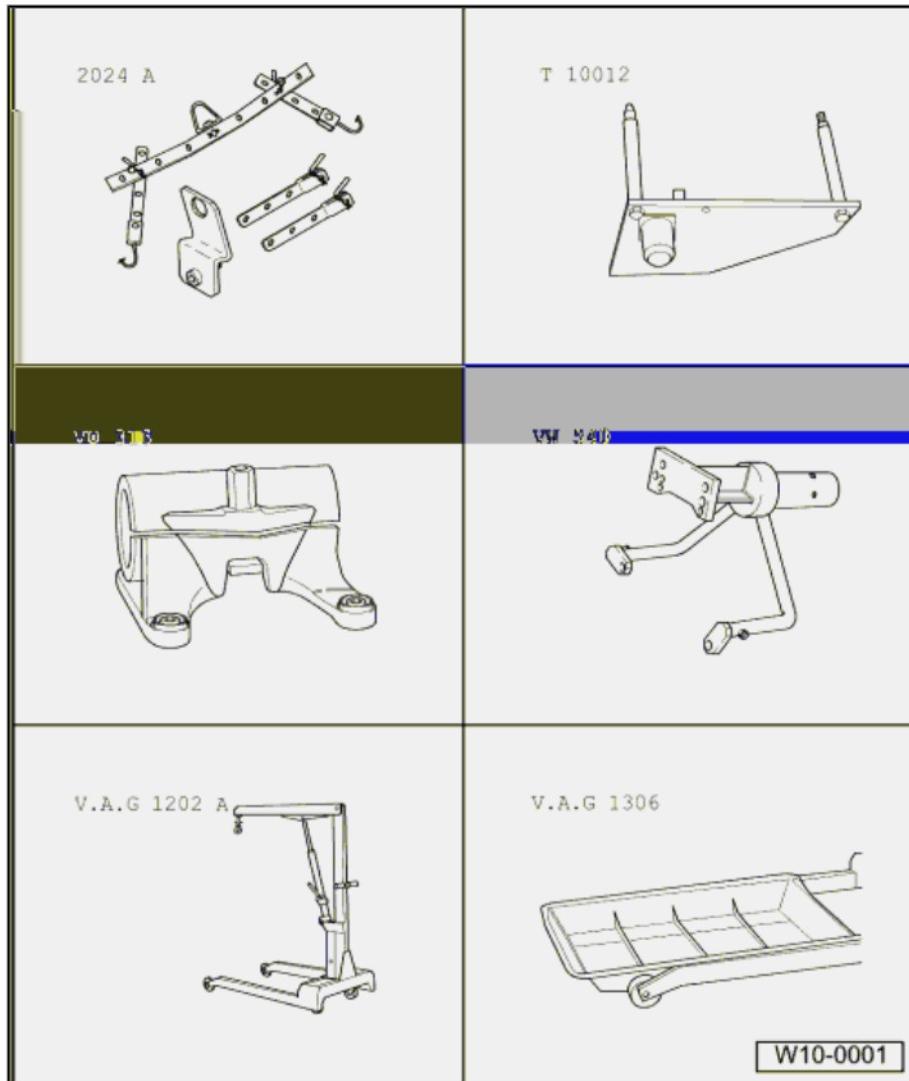


10 – Cylinders, engine block, support, protector

1 Engine - remove and install

Special tools and workshop equipment required

- ◆ Suspender or VW 055-2024A-
- ◆ Support -T 10012-
- ◆ Support for VW 643 or VW 643/1 -VW 313- or Rotary stand for engine and transmission - VAS 6095-
- ◆ Support -VW 540-
- ◆ Hydraulic hoist - V.A.G 1202 A-
- ◆ Oil collecting tray -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Torque wrench - 40 to 200 Nm (enc. 1/2") -VAG 1332-





- ◆ Transmission jack or engine + transmission set - VAG 1383A-
- ◆ Standart-type clamp pliers - VW 5162 (VWB) - ou - VAS 5024A-
- ◆ 5-step ladder -VAS 5085-
- ◆ Grease -G 000 100-
- ◆ Screw M10×25 / 8.8
- ◆ Cable tie

V.A.G 1331	V.A.G 1332
A long, thin metal rod with a handle at one end and a small hook or clamp at the other.	A similar long metal rod with a different clamp mechanism at the end.
V.A.G 1383 A	VAS 5024
A four-legged hydraulic transmission jack with a central vertical post and a horizontal top plate.	A pair of long-handled, articulated clamp pliers.
VAS 5085	
A standard five-step folding ladder.	

W10-0058

1.1 Notes on removal

- The engine is removed from below, together with the transmission.



WARNING

For installation works, especially in the engine compartment, due to reduced existing space, consider the following:

- ◆ All hoses (e.g. fuel, hydraulics, activated charcoal filter system, cooling system and cooling gas, brake fluid, vacuum) and electric cables must be restored to their original positions.
- ◆ Provide easy access to all the moving or hot parts.

- All the cable ties loosened or cut to remove the engine must be reinstalled at the same points upon installation.



Note

During the work sequence, the Battery -A- earth strap will have to be disconnected. Therefore, check first whether a code radio is installed. If so, first obtain the anti-theft system code.

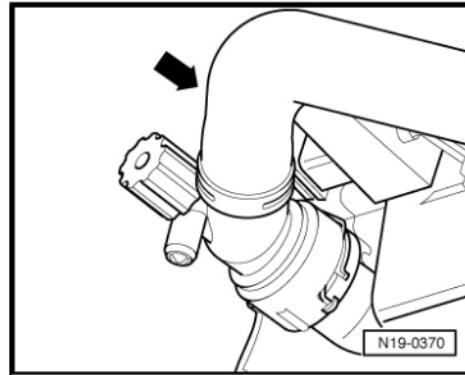
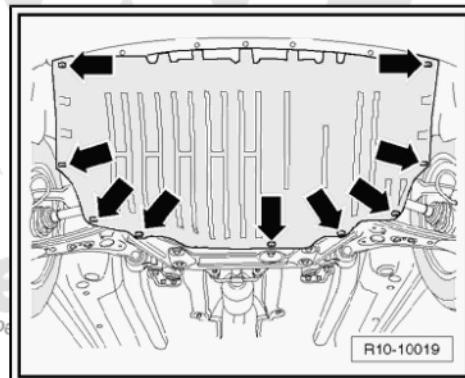
- With the ignition switched off, disconnect the Battery -A- earth strap.
- Open and close coolant reservoir cover to relieve the pressure in the cooling system.
- Remove the battery -A- and the battery support -A- .
- Remove the connection hose between the air filter and the intake air duct.
- Remove air filter.
- Remove the lower noise insulation from the engine.
- Remove the drive semi-shaft on the right side and loosen the one on the left side of the transmission. ⇒ Running gear; Rep. Gr. 40 ; Front suspension .
- Lift the left drive semi-shaft and tie it on the anti-roll bar.
- Remove the front part of the exhaust tube with the catalytic converter ⇒ [page 110](#) .
- Drain the cooling system ⇒ [page 75](#) .
- Remove the hoses from the engine with Standart-Type clamp pliers -VW 5162 (VWB) - ou - VAS 5024A- .

- Also remove the lower hose in the radiator -arrow- .
- Disconnect and release all the transmission electric connections, Generator (Alternator) -C- and Starter -B...- .
- Disconnect all the fitting, cooling, vacuum and intake hoses from the engine.
- Loosen the clutch hydraulic receiver cylinder: ⇒ Automatic / mechanical transmission; Rep. Gr. 30 ; Clutch - command system .
- Loosen the transmission gearshift lever: ⇒ Automatic/mechanical transmission; Rep. Gr. 34 ; Drive, housing .



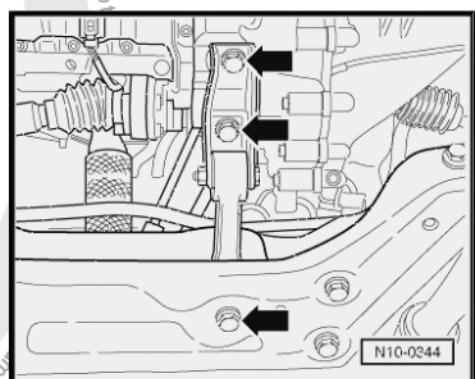
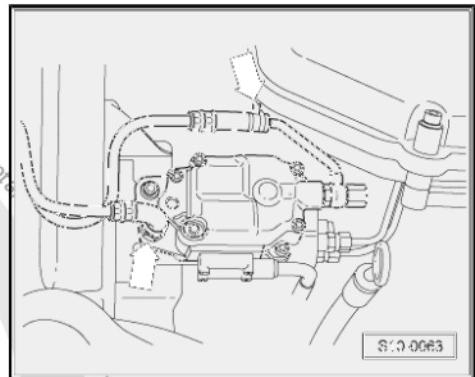
WARNING

- ◆ Both the fuel and the fuel tubes may become very hot (risk of burns)!
- ◆ In addition, the fuel system is under pressure! Before opening the system, place a cloth on the fitting and relieve the pressure by carefully loosening it!
- ◆ Always use goggles and gloves in all the installation works in the fuel system!





- Disconnect the fuel supply and return tubes -arrows- on the injector pump.
- Seal the tubes so as to prevent any dirt from entering the supply system.
- Follow cleaning rules [⇒ page 89](#).
- Disconnect and loosen the remaining electrical connectors from the engine.
- Remove the pendular support -arrows-.

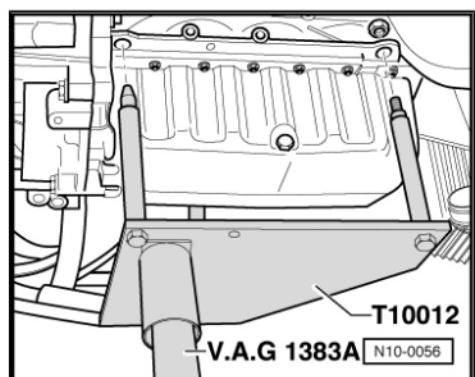


1.1.1 Vehicle with air climate control:

- Remove the Poly-V belt [⇒ page 15](#).
- Observe additional indications and assembly works [⇒ page 9](#).
- Remove Generator (Alternator) -C- .

1.1.2 Continued for all vehicles.

- Install the Support -T 10012- on the Transmission jack or engine + transmission set -VAG 1383A- .
- By using the fastening nut and the M10×25/ 8.8 screw, install the Support -T 10012- on the engine block with approx. 40 Nm.
- Lift slightly the engine and the gearbox using the Gearbox or Engine + gearbox combo jack -VAG 1383A- .

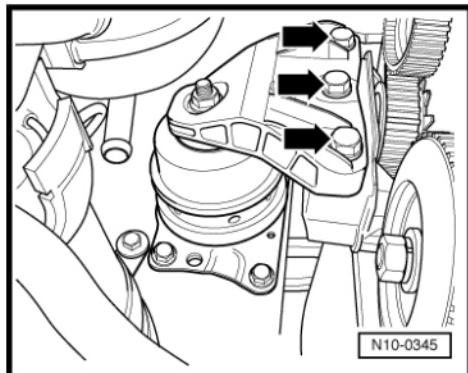




- Loosen, from above, the subframe by the engine supporting side -arrows- .



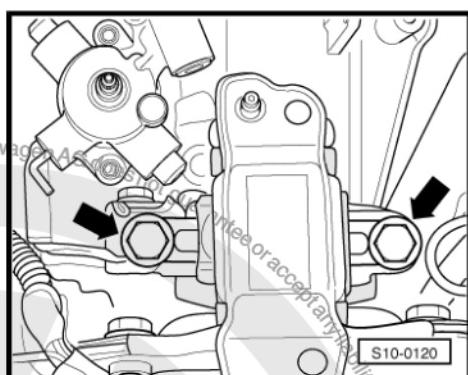
To remove the fastening screws, use the 5-step ladder -VAS 5085- .



- Loosen, from above, the subframe by the transmission supporting side -arrows- .
- Carefully lower the engine with the transmission.



Carefully, lower the engine and the transmission in order to prevent damages to the body.



1.2 Fasten the engine on assembly stand

To perform assembly works, it is necessary to fasten the engine on the Transmission jack or engine + transmission set -VAG 1383A- or Support -VW 540-.

1.2.1 Sequence of operations

- Release the transmission.



1.2.2 Continued for all vehicles.

- Raise the Suspending device or VW 055 -2024A- as follows and remove it from the Transmission jack or engine + transmission set -VAG 1383A- , by using the Hydraulic winch - V.A.G 1202 A- .

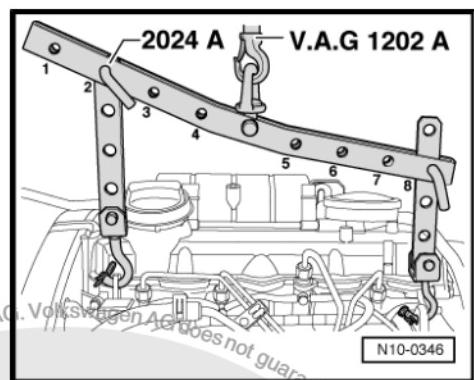
Pulley side: position 4 of the vertical rod. Orifice on the sustaining bar in position 2

Steering wheel side: position 3 of the vertical rod. Orifice on the sustaining bar in position 8



WARNING

Use safety locks on the hooks and pins -arrows-



Note

- ◆ Alignment positions marked as 1...8 on the supporting bar remain faced to the pulley.
- ◆ The holes in the vertical rods are counted from the hook.
- Fasten the engine with the Support for VW 643 or VW 643/1 -VW 313- or Rotary stand for engine and transmission -VAS 6095- .

1.3 Notes on installation

Install by inverting the removal sequence, paying attention to the following:

- Check clutch bearing for wear and replace it, if necessary.
- Slightly lubricate the clutch roller bearing, the roller bearing guide bushing and the primary shaft splines with Grease -G 000 100- .
- Check whether there are coupling guides for engine/transmission on the engine block and install them, if necessary.
- When installing the subframe, pay attention to the mobility in relation to the drive semi-shafts.



Note

Tightening torques for the subframe pads [page 8](#).

- Align the engine without tension by moving and occasionally loosening the engine support also on the body.
- Install gearshift lever: ⇒ Automatic/mechanical transmission; Rep. Gr. 34 ; Drive, housing .
- Install the clutch hydraulic receiver cylinder: ⇒ Automatic / mechanical transmission; Rep. Gr. 30 ; Clutch - command system .
- Remove cooling and vacuum system hoses.

1.3.1 Vehicles with air conditioning

- Install the air conditioning compressor: ⇒ Aeration system ; Rep. Gr. 87 ; Air conditioning .



- Install the Generator (Alternator) -C- .

1.3.2 Continued for all vehicles.

- Install Poly-V belt [page 15](#) .
- Electrical connections and their positions: ⇒ Electrical equipment; Rep. Gr. 97 ; Cables and wiring harnesses .
- Install the front part of the exhaust tube with catalytic converter [page 110](#) .
- Fill cooling system [page 75](#) .
- Perform a test drive and check fault memory [page 107](#) .

1.4 Tightening torques

Location	Tightening torque	
Screws and nuts	M6	10 Nm
	M7	15 Nm
	M8	25 Nm
	M10	40 Nm
	M12	60 Nm
Engine to transmission fastening screws	M10	45 Nm
Engine to transmission fastening screws	M12	80 Nm
Drive shafts and flanges		40 Nm
Exhaust tube		40 Nm



Note

Subframe tightening torques [page 8](#) .

1.5 Supports for the power-drive group

1.5.1 Tightening torques



WARNING

Before loosening the screws, the subframes must be fastened with Support or VW 061 -10-222A-



WARNING

Always replace self-locking nuts and screws subject to angular torque

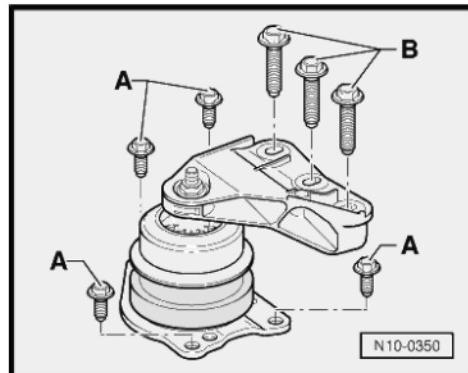


Power-drive group support, engine

A¹⁾ = 20 Nm + 90°.

B¹⁾ = 30 Nm + 90°.

1) Replace

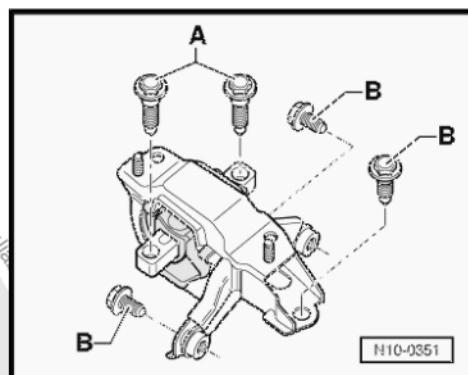


Power-drive group support, transmission

A²⁾ = 40 Nm + 90°.

B²⁾ = 50 Nm + 90°.

2) Replace.

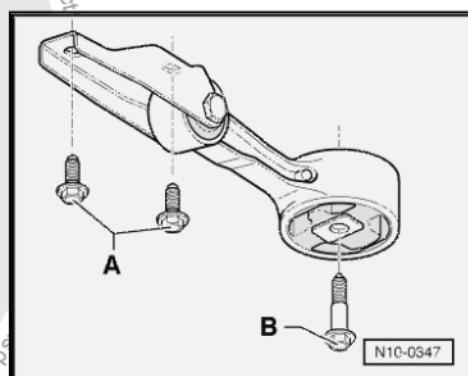


Pendular support

A³⁾ = 30 Nm + 90°.

B³⁾ = 40 Nm + 90°.

3) Replace.



1.6 Additional notes and installation works in vehicles with air conditioning



WARNING

Air conditioning cooling gas circuit should not be opened.



Note

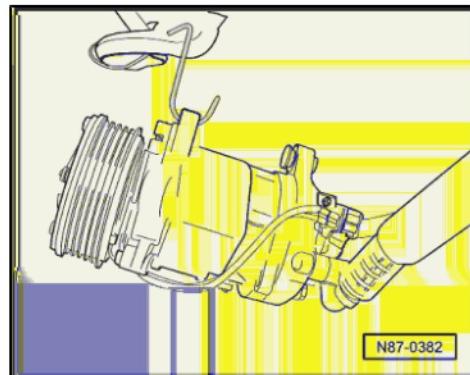
To avoid damages on the condenser and refrigerant gas tubes/hoses, make sure the latter are not twisted, bent or excessively stretched.

To be able to remove and install the engine without opening the cooling gas circuit:

- Remove cooling gas hose clamp(s).
- Remove the Poly-V belt [⇒ page 15](#).



- Remove Generator (Alternator) -C- .
- Remove air conditioning compressor ⇒ Aeration System;
Rep. Gr. 87 ; Air conditioning .
- Fasten the compressor to the body so that the cooling gas
tubes/hoses are not under tension.





13 – Crankshaft, pistons

1 Engine - disassemble and assemble



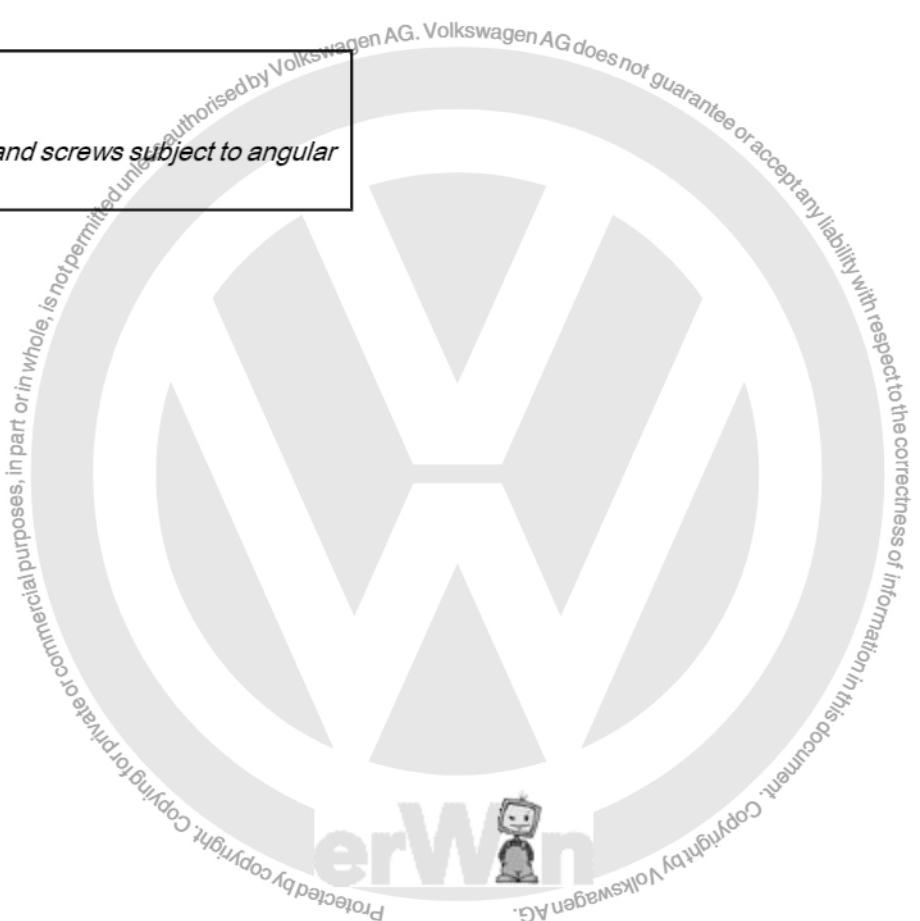
Note

- ◆ To perform assembling works, fasten the engine on the assembly stand, using the Support for VW 643 or VW 643/1-VW 313- or Rotary stand for engine and transmission -VAS 6095-.
- ◆ It is necessary to carefully clean the oil ducts and to replace the oil filter if, when servicing the engine, significant amounts of metal particles and detached particles are found in the oil, due to abrasion or wear resulting from seizing (for instance from the connecting rods or bearing shells). This procedure avoids damage.
- ◆ Before performing assembly works, it is necessary to lubricate support and sliding surfaces.



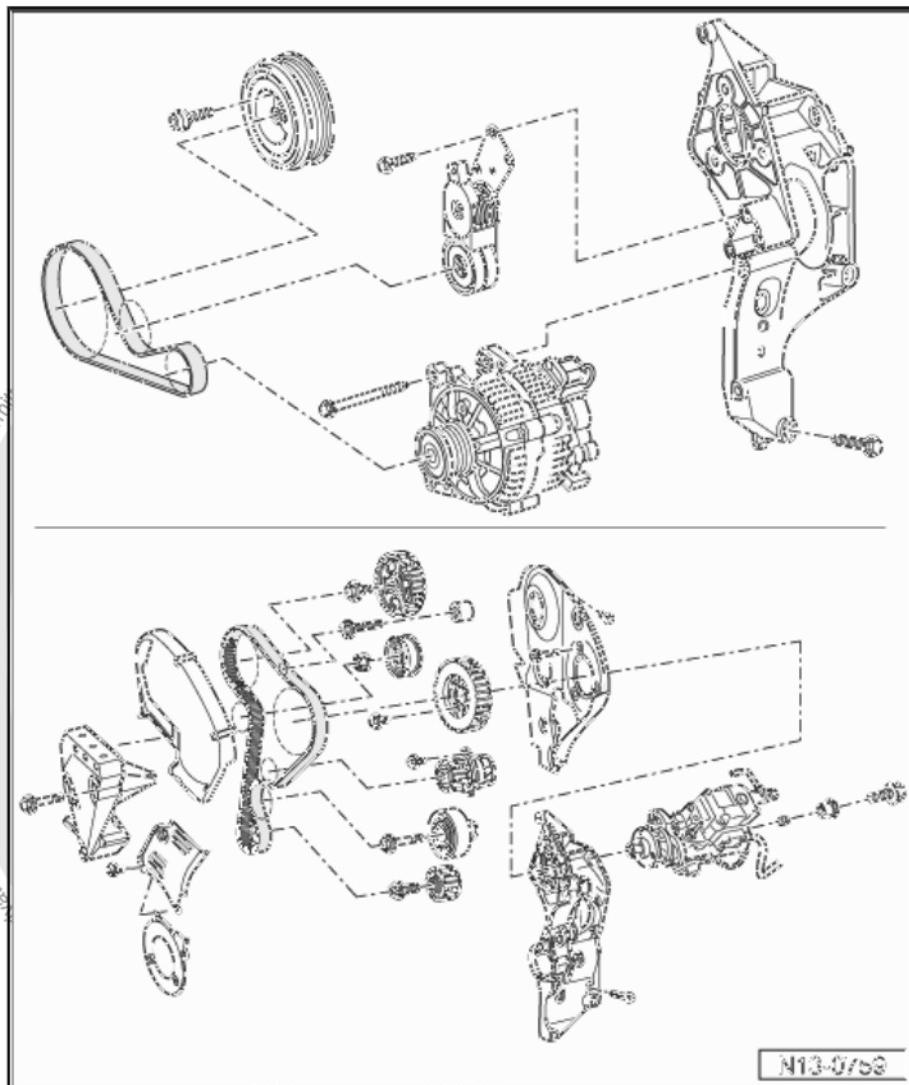
WARNING

Always replace self-locking nuts and screws subject to angular torque





Use of commercial purposes, in part or in whole, is not permitted.



Part I



1 - 10 Nm + 90°

- Replace after each removal.

2 - Pulley/ vibration damper

- The installation is only possible in one position (displaced holes).

3 - 25 Nm

4 - Tensioning element for Poly-V belts

5 - Compact support

- When installing, pay attention to the coupling guide centering.
- To the Generator (Alternator) -C- .
- In case of additional accessories with air conditioning compressor.

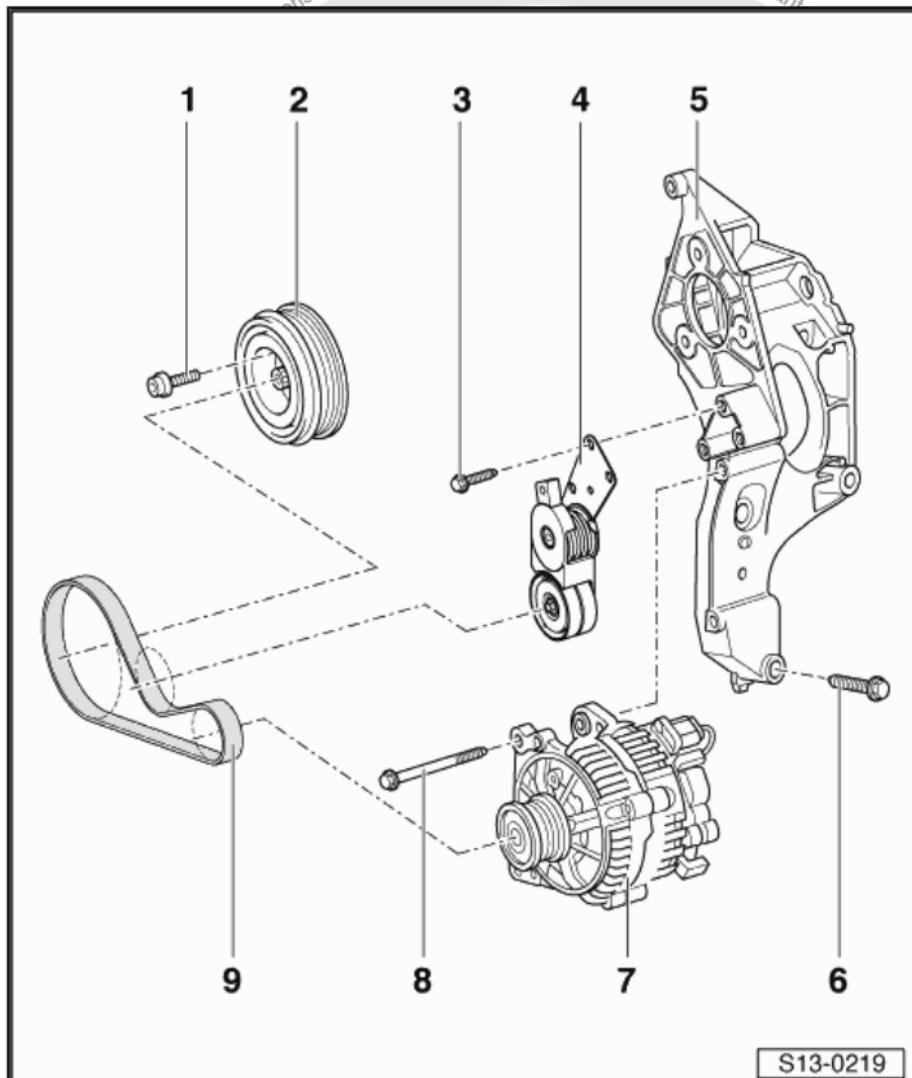
6 - 45 Nm

7 - Generator (Alternator) -C-

8 - 25 Nm

9 - Poly-V belt

- Mark direction of operation before removing.
- Check for wear.
- Do not bend.
- Remove and install [⇒ page 15](#).



S13-0219

Part II



1 - 45 Nm

2 - Engine support

3 - Mechanical distribution upper cover

4 - Toothed belt

- Mark the rotation direction before removing.
- Check for wear.
- Do not bend.
- Remove and install, adjust [⇒ page 36](#).

5 - 25 Nm

6 - 25 Nm

- Adjust the toothed belt [⇒ page 36](#).

7 - 20 Nm

8 - 45 Nm

9 - Camshaft gear

- Toothed belt - remove and install, adjust [⇒ page 36](#).

10 - Tensioning pulley

- Installation position [⇒ page 15](#)
- Check [⇒ page 17](#).

11 - Pulley

12 - Injector pump gear

13 - 10 Nm

14 - 30 Nm

15 - 15 Nm

16 - Mechanical distribution front cover

17 - Water pump

- Remove and install [⇒ page 79](#).

18 - Pulley

19 - Crankshaft gear

20 - 30 Nm

21 - Sleeve

22 - Fastening nut

23 - Injector pump

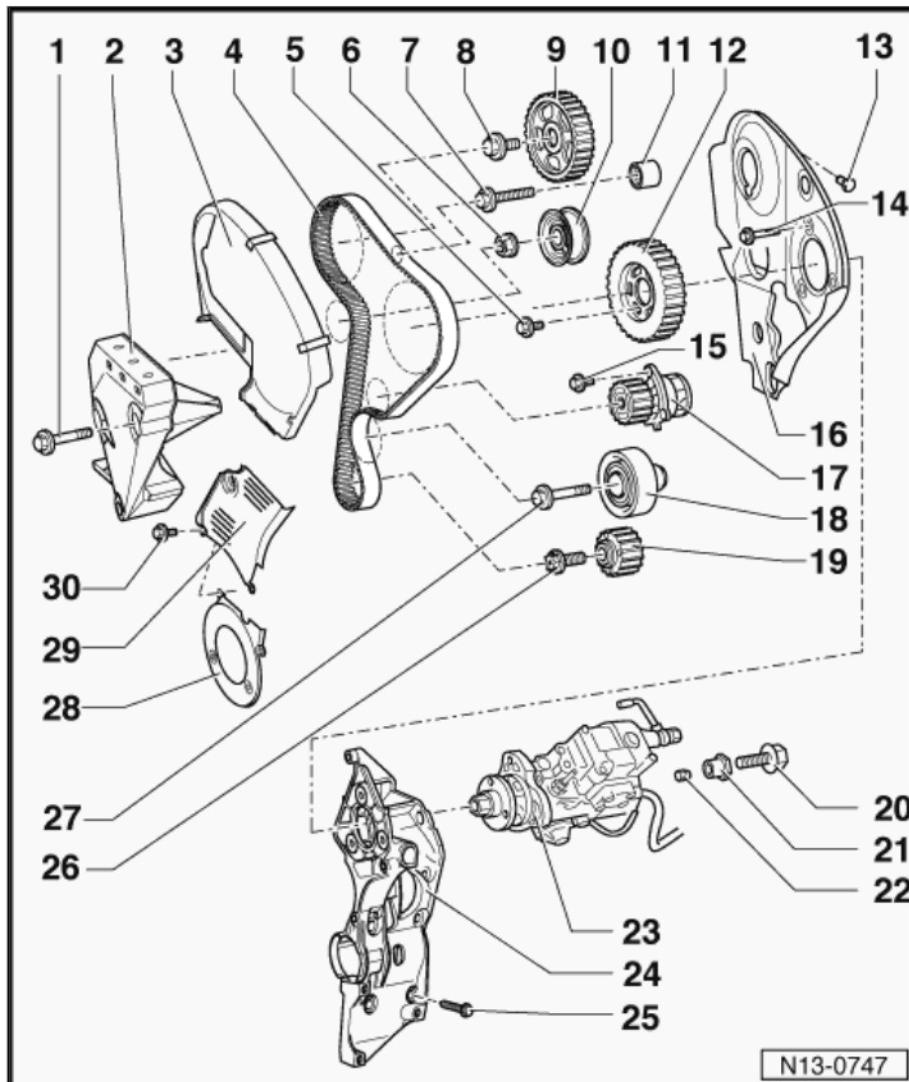
- Remove and install [⇒ page 99](#).

24 - Compact support

25 - 45 Nm

26 - 120 Nm + 90°

- Replace after each removal.
- To tighten and loosen, immobilise with the Spanner - 3415.
- Do not apply additional oil or grease on the thread and flange.





- Tightening continuation can be carried out in various steps.

27 - 40 Nm + 90°

- Replace after each removal.

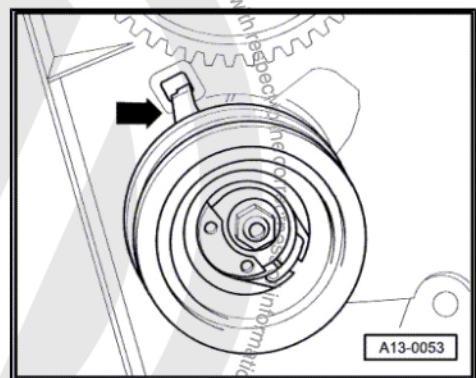
28 - Mechanical distribution lower cover

29 - Protector

30 - 10 Nm

Installation position of the toothed belt semi-automatic tensioning pulley

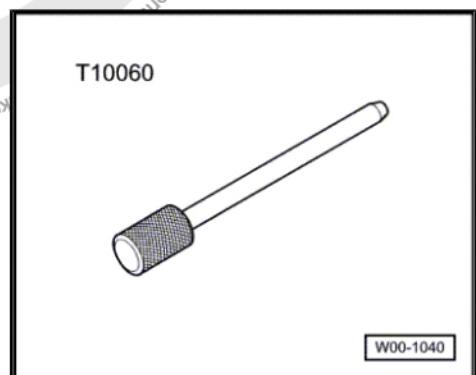
- The fastening device -arrow- of the tensioning pulley must fit into the slot of the mechanical distribution rear cover.



1.1 Poly-V belt - remove and install

Special tools and workshop equipment required

- ◆ Pin -T 10060-



1.1.1 Remove the Poly-V belt

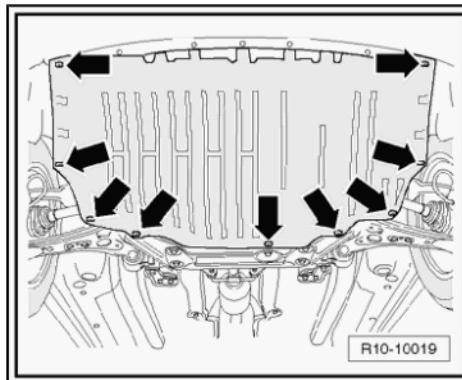


Note

- ◆ *Mark the rotation direction before removing the Poly-V belt.*
- ◆ *When installing the belt, pay attention to the correct seating on the pulleys.*

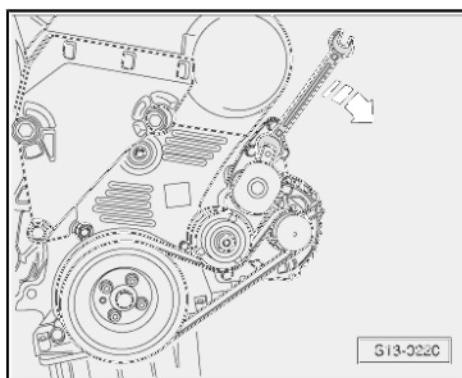


- Remove the lower noise insulation from the engine.
- Mark the Poly-V belt rotation direction.



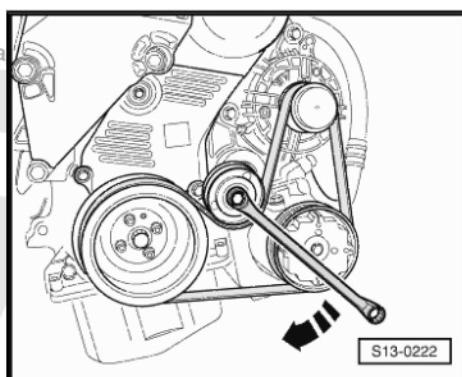
1.1.2 Vehicles without air conditioning compressor

- By using a fixed wrench, turn the tensioning device clockwise -arrow- to loosen the Poly-V belt.
- Lock the tensioning device with the Pin -T 10060 - .
- Remove the Poly-V belt.



1.1.3 Vehicles with air conditioning compressor

- By using a star wrench, turn the tensioning device clockwise -arrow- to loosen the Poly-V belt.
- Lock the tensioning device with the Pin -T 10060 - .
- Remove the Poly-V belt.



1.1.4 Install the Poly-V belt.

- Install in reverse order from the removal.



Note

- ◆ Before installing the Poly-V belt, make sure all assemblies (Generator (Alternator) -C-, air conditioning compressor, injector pump) are properly installed.
- ◆ When installing the Poly-V belt, pay attention to the operation direction and correct seating of the belt in the respective pulleys.

When the job is finished:





- Start the engine and check the correct travel of the Poly-V belt.

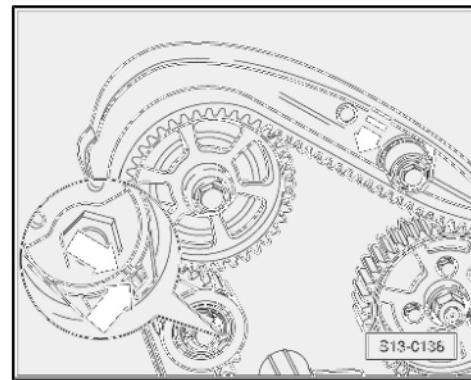
1.2 Toothed belt semi-automatic tensioning pulley - check

1.2.1 Checking conditions

- Toothed belt installed and adjusted.

1.2.2 Checking sequence

- Press the toothed belt -seta- firmly with the thumb. Notch and elevation -arrow- must be displaced.
- Release the toothed belt. The tensioning pulley must return to its initial position. (Notch and elevation are juxtaposed again).
- If the notch and the elevation are not juxtaposed, loosen the tensioning pulley and adjust the toothed belt tension
⇒ page 36 .
- If the toothed belt tension is changed:
- Check the injection start dynamically, and occasionally, adjust functions and components ⇒ page 108 .





2 Crankshaft and flywheel seal - remove and install



Note

Clutch repair work: ⇒ Automatic mechanical transmission; Rep. Gr. 30; Clutch - command system.

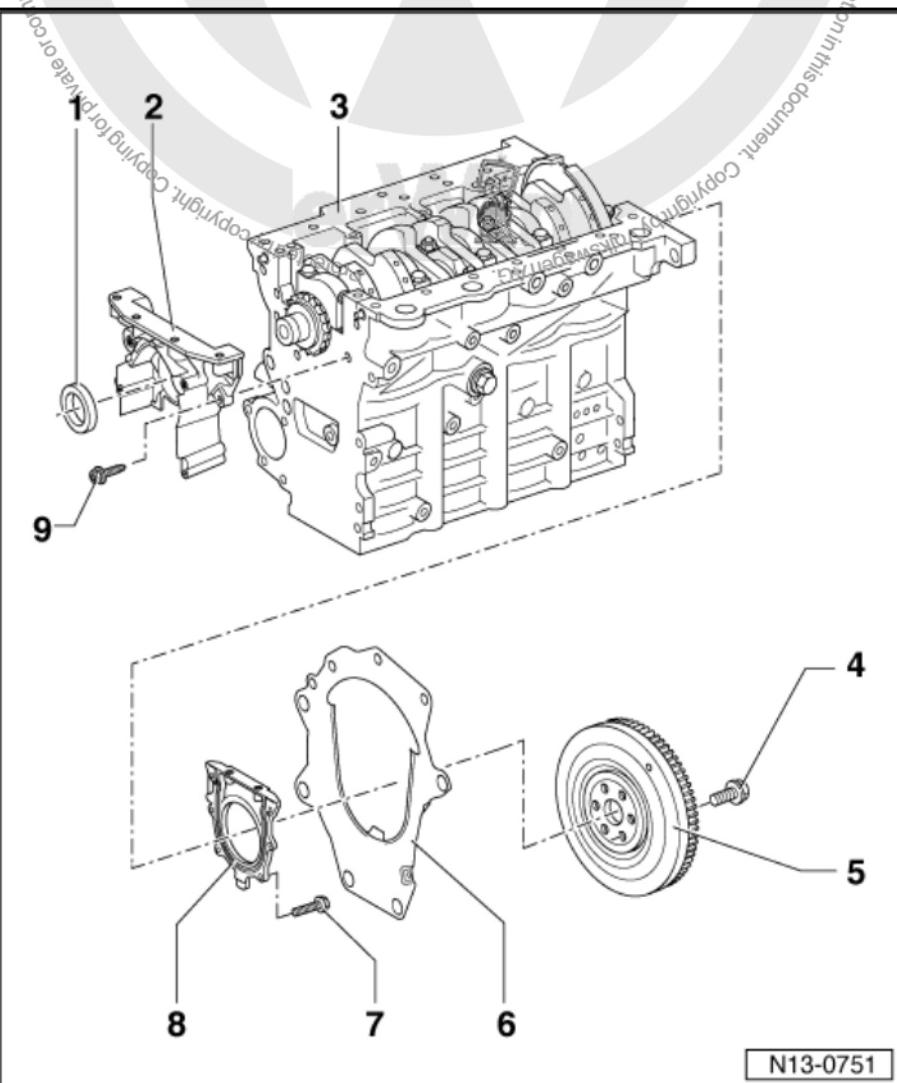


WARNING

Always replace self-locking nuts and screws subject to angular torque

1 - Crankshaft seal (pulley side)

- Do not lubricate or grease on the seal lip.
- Before installation, remove oil residues from crankshaft trunnion with clean cloth.
- Replace the crankshaft seal (pulley side)
⇒ [page 20](#).



3 - Engine block

- Crankshaft - remove and install ⇒ [page 26](#).
- Piston and connecting rod - remove and install
⇒ [page 28](#).

4 - 60 Nm + 90°

- Replace after each removal.
- The angular torque can be applied in several stages.

5 - Steering wheel

- For removing and installing, use the Flywheel lock -T 10044- and Sleeve -T 10044/1- ⇒ [page 19](#)

6 - Intermediate plate

- It must seat on coupling guides.
- Do not damage or bend during installation.



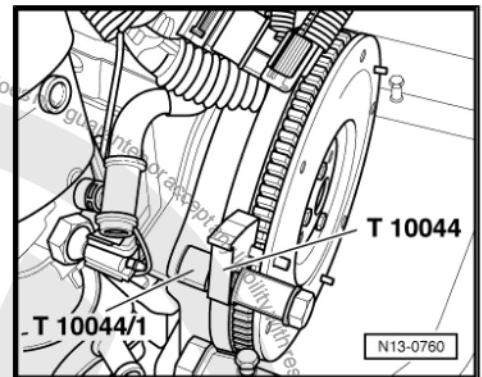
7 - 15 Nm

8 - Crankshaft flange (flywheel side) with seal

- Replace as a set only.
- Do not lubricate or grease on the seal lip.
- Before installation, remove oil residues from crankshaft trunnion with clean cloth.
- To install, use the coupling guide supplied by the manufacturer.
- The coupling guide can only be removed after installing the seal on the crankshaft trunnion.

9 - 15 Nm

Flywheel - remove and install



Special tools and workshop equipment required

- ◆ Flywheel lock -T10044- -T10044- with Sleeve -T10044/1-

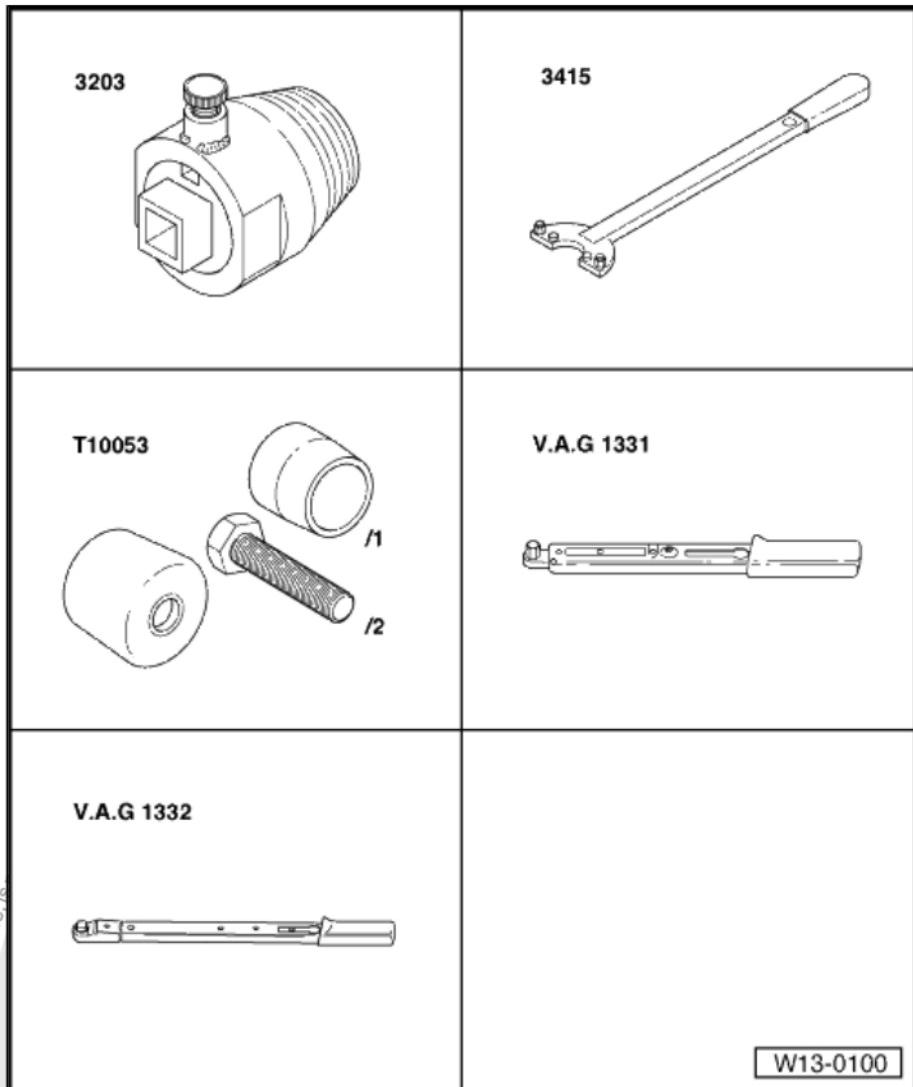
Fasten the Flywheel lock -T 10044- with a Sleeve -T10044/1- to remove and install the engine flywheel.



2.1 Crankshaft sealing (pulley side) - replace

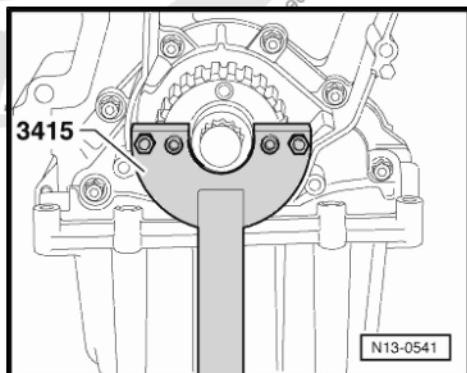
Special tools and workshop equipment required

- ◆ Puller -3203-
- ◆ Wrench -3415-
- ◆ Assembly sleeve -T 10053-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Torque wrench - 40 to 200 Nm (enc. 1/2") -VAG 1332-



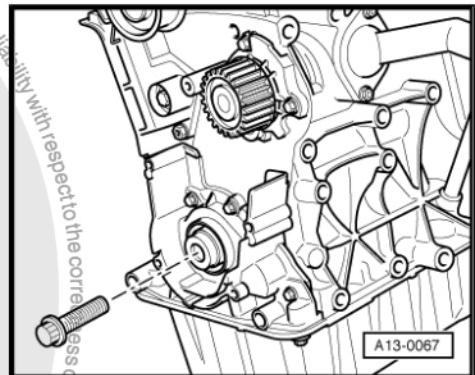
2.1.1 Removal

- Remove the left front wheel case cover ⇒ Body - External assembly works; Rep. Gr. 66 ; External equipment .
- Remove the Poly-V belt [⇒ page 15](#) .
- Remove the toothed belt [⇒ page 36](#) .
- Remove the toothed belt . To do that immobilise the crank-shaft gear with the Wrench -3415- .

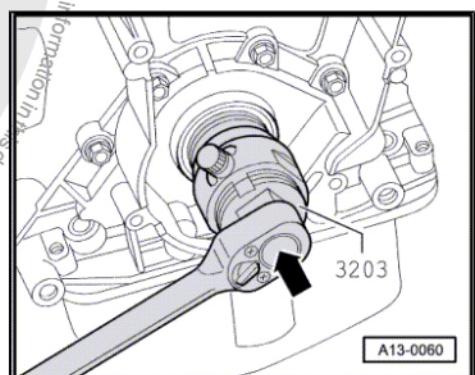




- To guide the Puller -3203-, install the central screw manually on the crankshaft to the limit.
- Turn the inside part of the external part of the Puller -3203- nine turns (approx. 20 mm) and immobilise it with the knurled screw.



- Lubricate the threaded head of Puller -3203-, place and turn it with strong pressure on the seal.
- Loosen the knurled screw and turn the inner part of the Puller -3203- against the crankshaft until extracting the seal.



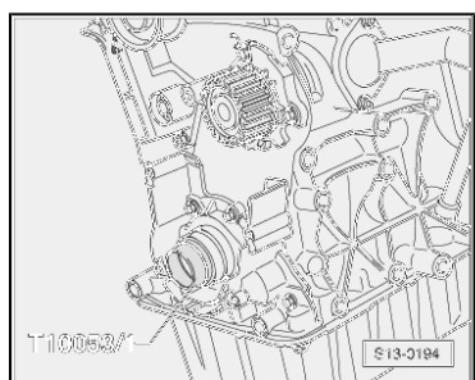
2.1.2 Installation



Note

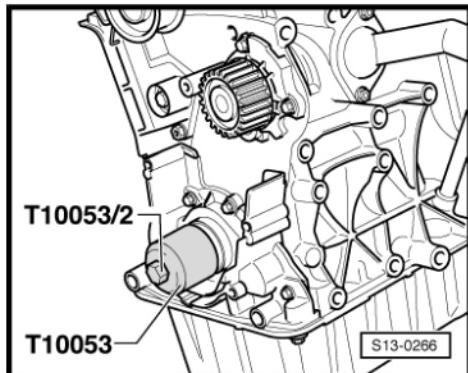
Gradual introduction of PTFE seals (Feature: springless, wider seal lip). It is prohibited to lubricate the seal's sealing lip. An old model of seal with radial grooves (springless) may be replaced by a PTFE seal, but the inverse replacement is not permitted.

- With a clean cloth, remove oil residues from the crankshaft trunnion.
- Place the Sleeve -T10053/1- onto the crankshaft trunnion.
- Slide the seal over the Sleeve -T10053/1-, in the crankshaft trunnion, and remove the Sleeve -T10053/1- .





- Install the seal with the Assembly sleeve -T 10053- and screw -T10053/2- (Left turning light bulb -M18- x 1.5 x 60), pressing it to the stop.



- Install the crankshaft gear and immobilise with the Spanner -3415-. Tightening torque: 120 Nm + 90°.

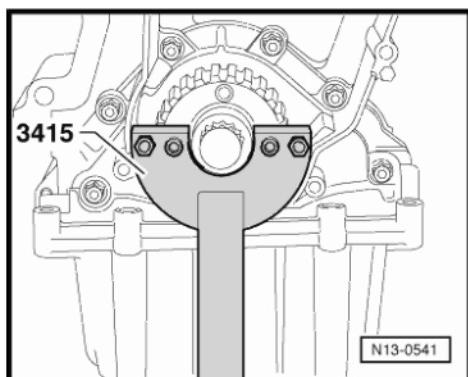


Note

The thread and the screw head support face must be free from oil and grease.

Installing the toothed belt and adjusting distribution times
[⇒ page 36](#).

- Install Poly-V belt [⇒ page 15](#).

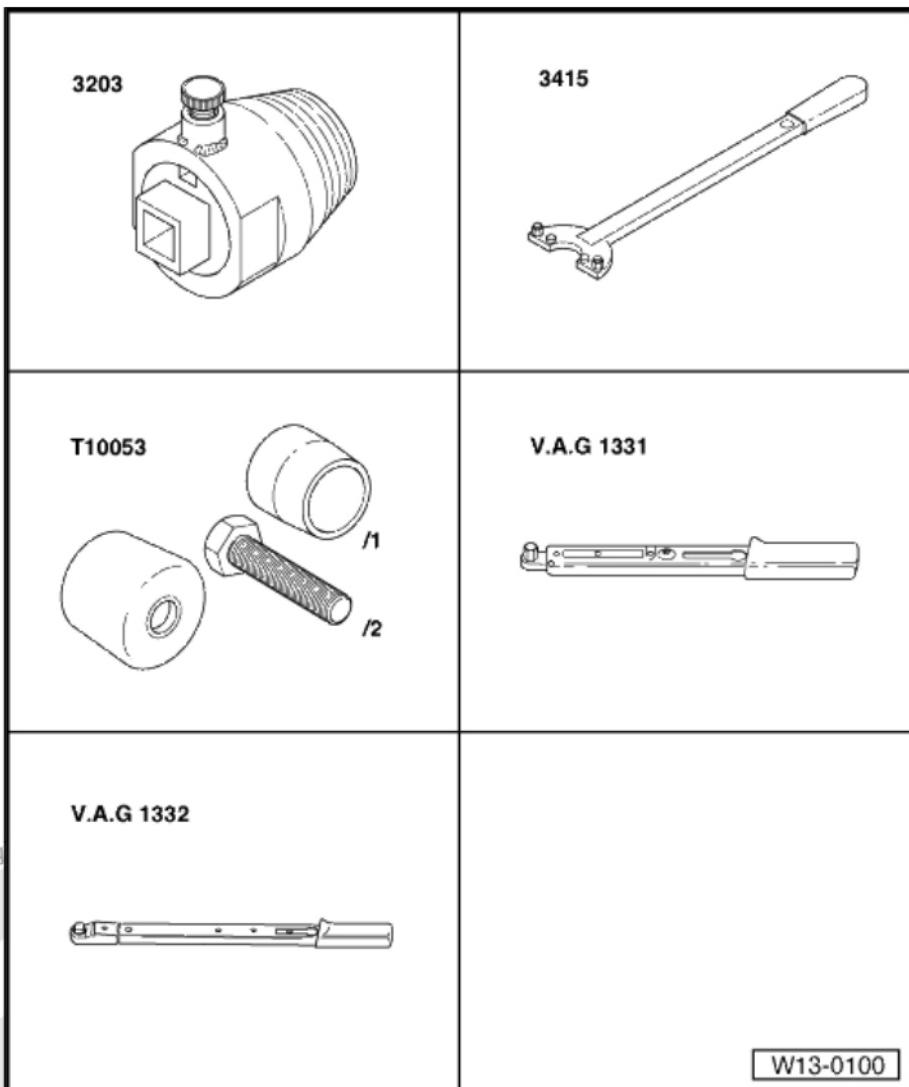




2.2 Crankshaft flange (pulley side) - remove and install

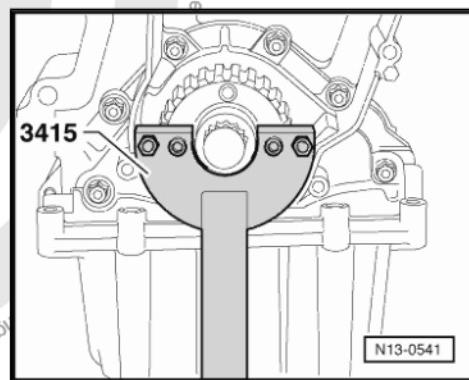
Special tools and workshop equipment required

- ◆ Puller -3203-
- ◆ Wrench -3415-
- ◆ Assembly sleeve -T 10053-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Torque wrench - 40 to 200Nm (enc. 1/2") -VAG 1332-



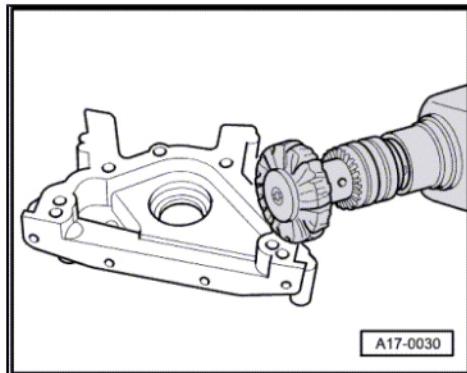
2.2.1 Removal

- Remove the Poly-V belt [page 15](#).
- Remove the toothed belt [page 36](#).
- Remove the crankshaft gear. To do so, immobilise the gear using the Wrench -3415-.
- Drain the engine oil.
- Remove the crankcase [page 65](#).
- Loosen the front flange.
- Remove the front flange, if necessary, by loosening it with light knocks with a rubber hammer.
- Eliminate residues of Engine silicone seal -D176 404 A2 or A3- remaining on the engine block with a spatula.





- Remove residues of Engine silicone seal -D176 404 A2 or A3- with the plastic brush installed in drill (use goggles).
- Clean the sealing surfaces. They must be free from oil and grease.



2.2.2 Installation



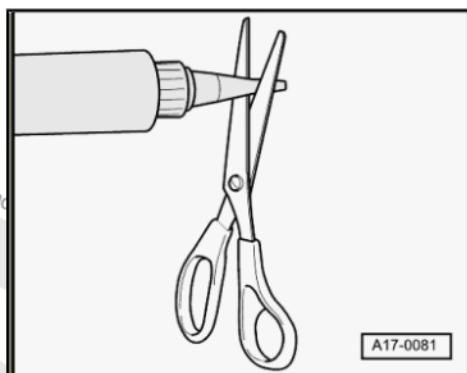
Note

- ◆ Observe the expiration date of the Engine silicone seal -D176 404 A2 or A3- .
 - ◆ After applying the Engine silicone seal -D176 404 A2 or A3- , the flange must be installed within 5 minutes.
- Cut the tube injector on front marking (ejector Ø is approx. 3 mm).

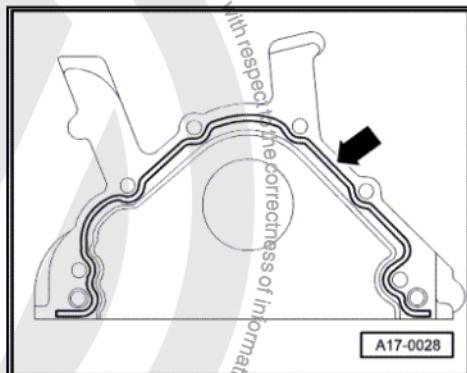


Note

- ◆ The Engine silicone seal - D176 404 A2 or A3- fillet should not be thicker; otherwise, the excess of Engine silicone seal -D176 404 A2 or A3- may fall into the crankcase, where it may clog the screen filter in the suction tube.
- ◆ Before applying the Engine silicone seal -D176 404 A2 or A3- fillet, cover the seal surface with a clean cloth.



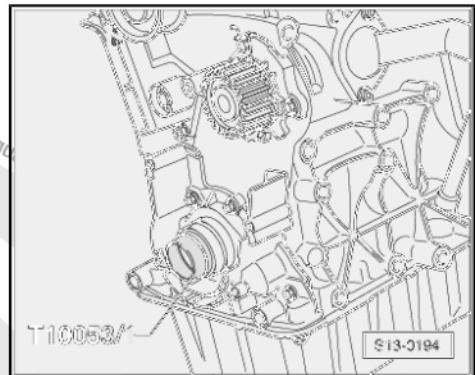
- Apply Engine silicone seal -D176 404 A2 or A3- fillet on the clean flange seal surface, as shown in the illustration.
- Immediately position the flange and tighten the screws lightly.



**Note**

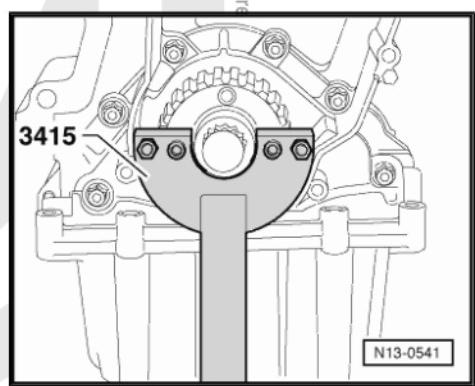
To place the flange with installed seal, use the Sleeve - T10053/1- .

- Tighten the flange fastening screws in a cross pattern. Tightening torque: 15 Nm.
- Install crankcase [⇒ page 65](#).

**Note**

After installation, the Engine silicone seal -D176 404 A2 or A3- must dry for 30 minutes. Motor oil may be replenished only after this time period has elapsed.

- Install the crankshaft gear and immobilise with the Spanner -3415-. Tightening torque: 120 Nm + 90°.

**Note**

The thread and the screw head support area must be free from oil and grease.

Installing the toothed belt and adjusting distribution times
[⇒ page 36](#).

- Install Poly-V belt [⇒ page 15](#).



3 Crankshaft - remove and install



WARNING

Always replace self-locking nuts and screws subject to angular torque

1 - Bearing shells 1, 2, 3, 4 and 5

- For bearing cover without lubrication groove.
- For crankcase with oil groove.
- Do not mix the bearing shells when reusing them (mark them)

2 - 65 Nm + 90°

- Replace after each removal.
- To measure the radial clearance, tighten to 65 Nm, without angular torque.

3 - Bearing cap

- Bearing cap 1: Crankshaft pulley side:
- Bearing cap 3: With notches for adjusting rings.
- The shoulders for placing the bearing shells, crankcase/bearing cap must be overlapped.

4 - Bearing 3 shell bearing

- For bearing cover without lubrication groove.
- For engine block, with lubrication groove.

5 - Adjustment rings

- For bearing 3 cover.
- Check fastening.

6 - Rotor

- To Engine speed sensor - G28-

7 - 10 Nm + 90°

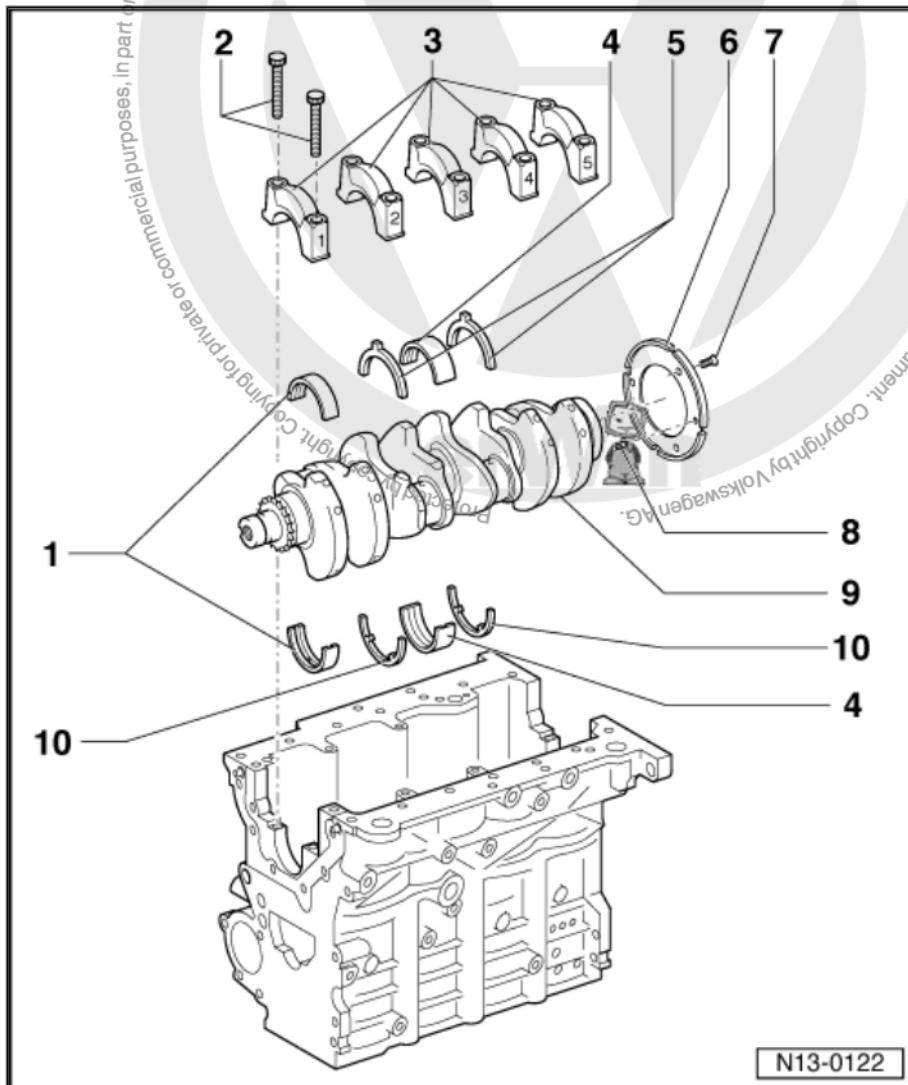
- Replace after each removal.

8 - Adjustment pin

- Check crankshaft salience [⇒ page 15](#)

9 - Crankshaft

- New axial clearance: 0.07...0.17 mm. Wear limit: 0.37 mm.
- Measure radial clearance with "Plastigage": new: 0.03...0.08 mm. Wear limit: 0.17 mm.
- Do not rotate crankshaft while measuring radial clearance.
- Crankshaft measures [⇒ page 26](#).



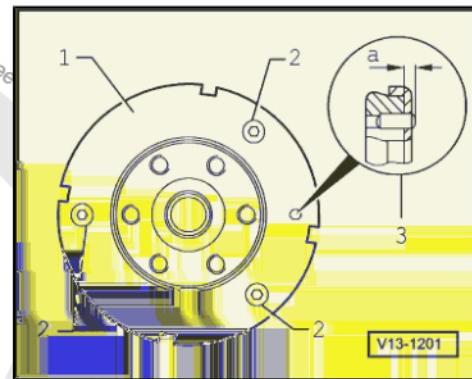
N13-0122



10 - Adjustment rings

- For the engine block, bearing 3.
- Check fastening.

Check projection of the crankshaft adjustment pin



Special tools and workshop equipment required

- ◆ Depth gauge

Checking sequence

- Check projection -a- of the crankshaft adjustment pin with the removed flywheel -1- with a depth gauge. -1- Engine flywheel.
-2- Fastening screw. -3-- adjustment pin projection a
= ~2.5...3.0 mm.

3.1 Crankshaft measurements

(measures in mm)

Grinding measure	Crankshaft bearing trunnion \varnothing - connecting rod bearing crankpin \varnothing -	
basic measure	-0,022 54,00 -0,042	-0,022 47,80 -0,042
First grinding	-0,022 53,75 -0,042	-0,022 47,55 -0,042
Second grinding	-0,022 53,50 -0,042	-0,022 47,30 -0,042
Third grinding	-0,022 53,25 -0,042	-0,022 47,05 -0,042



4 Pistons and connecting rods - remove and install



Note

All contact and bearing surfaces must be lubricated with oil before assembly.



WARNING

Always replace self-locking nuts and screws subject to angular torque

1 - Segment rings

- Displace the opening by 120°.
- Remove and install with the ring pliers.
- Reference "TOP" points towards the piston head.
- Check opening between ends [⇒ page 29](#)
- Check ring clearance in the piston channel
[⇒ page 30](#)

2 - Piston

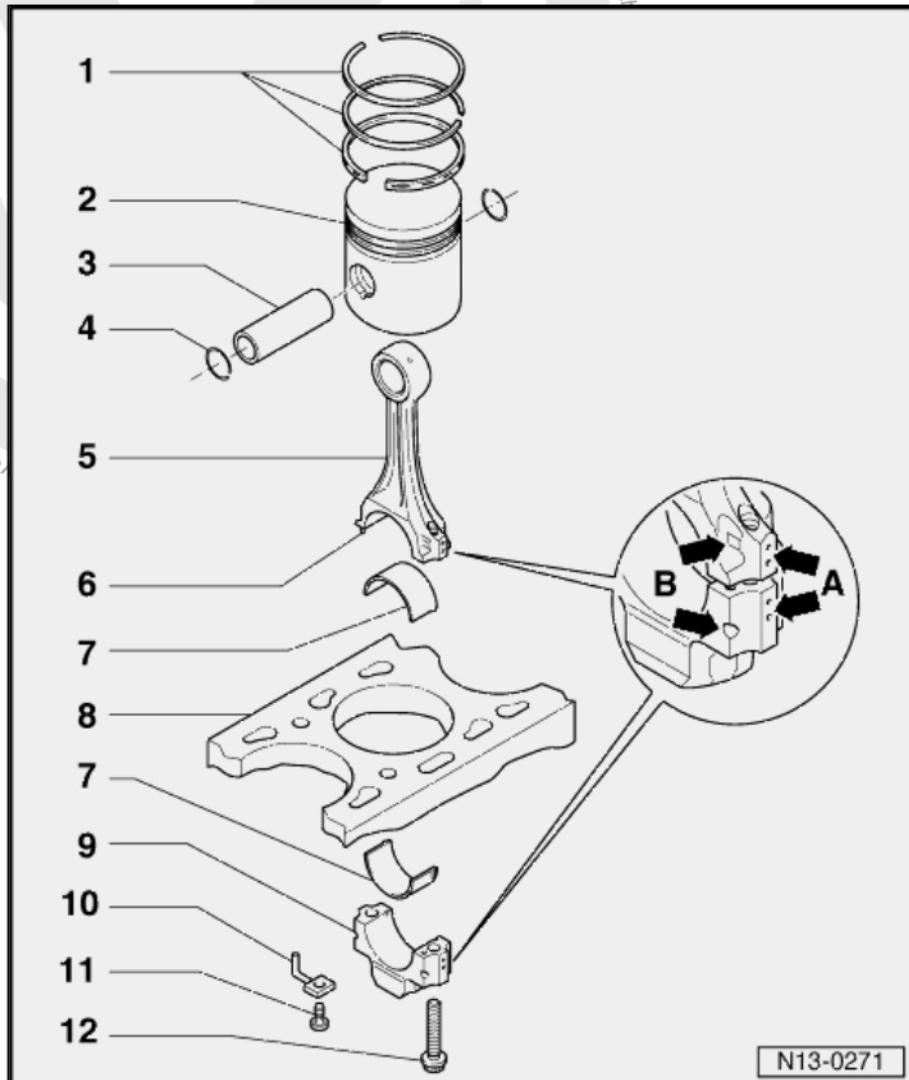
- With combustion chamber.
- Mark the installation position and the correspondence with the cylinder.
- Piston/cylinder installation position
[⇒ page 31](#)
- The -arrow- on piston head points to the pulley side.
- Install with the ring compression strap.
- In case of cracks on piston, replace it.
- Check the piston protrusion [⇒ page 31](#).

3 - Piston pin

- In case of difficulties in the removal, heat the piston to 140 °F.
- Remove and install with Puller and Fitter -VW 222- .

4 - Piston pin retaining ring

- Replace.



N13-0271

**5 - Connection rod**

- Replace as a set only.
- Mark correspondence with cylinder -A-.
- Installation position: Marks -B- point towards the pulley side.

6 - Adjustment pin

- The adjustment pin must be firmly positioned on the connecting rod.

7 - Bearing shell

- Observe the installation position.
- Do not mix used bearing shells (mark them).
- Pay attention to the correct seating in the retention saliences.
- Axial clearance: limit for wear: 0.37 mm.
- Measure radial clearance with "Plastigage": limit for wear: 0.08 mm. Do not move the crankshaft while measuring radial clearance.

8 - Engine block

- Check cylinder diameter [page 30](#)
- Piston and cylinder dimensions [page 32](#)

9 - Connecting rod cap

- Observe the installation position.

10 - Oil ejector

- For piston cooling.

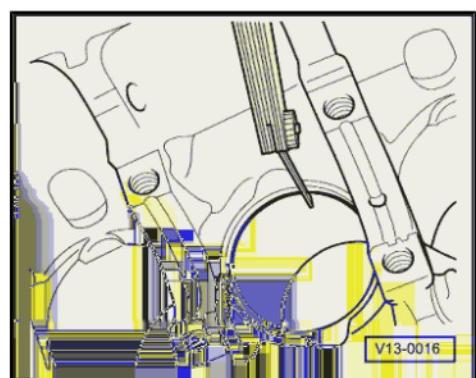
11 - 25 Nm

- Install without seal.

12 - Connecting rod screw, 30 Nm + 90

- Replace after each removal.
- Lubricate the thread and the contact surface.
- Use the used screw for measuring radial clearance.

Opening of piston ring ends - check



Special tools and workshop equipment required

- ◆ Feeler gauge

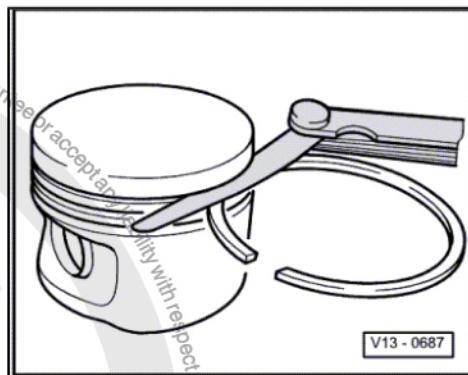


Checking sequence

- Insert the ring in right angle from top up to the cylinder lower opening, with a distance of approx. 15 mm up to the cylinder edge.

Segment ring measures in mm	new	Wear limit
1. Compression ring	0,25...0,40	1,0
2. Compression ring	0,20...0,40	1,0
Oil scraper ring	0,25...0,50	1,0

Check ring clearance in the piston channel



Special tools and workshop equipment required

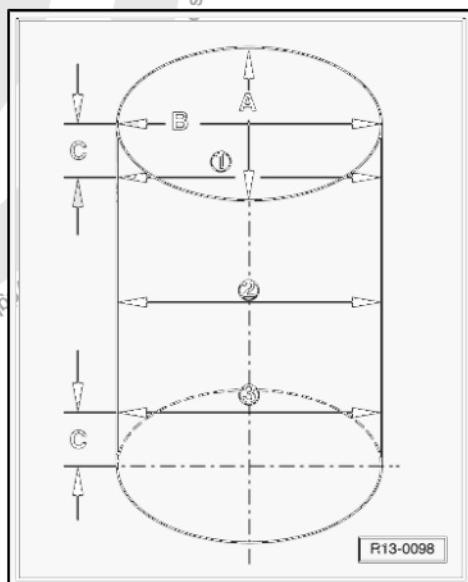
- ◆ Feeler gauge

Checking sequence

Clean the piston groove before checking.

Segment ring measures in mm	new	Wear limit
1. Compression ring	0,06...0,09	0,25
2. Compression ring	0,05...0,08	0,25
Oil scraper ring	0,03...0,06	0,15

Check cylinder diameter



Special tools and workshop equipment required

- ◆ Internal micrometer 50...100 mm

Checking sequence

Measure three different places, in cross pattern, in transversal -A- and longitudinal -B- directions with a distance of 10.0 mm from upper and lower edges-C-. Tolerances in relation to max. nominal measure 0.10 mm.

**Note**

The cylinder diameter cannot be measured while the engine block is secured to the assembly stand with the Support -VW 540- or Rotating stand for engine and transmission -VAS 6095-, because that can lead to incorrect measures.

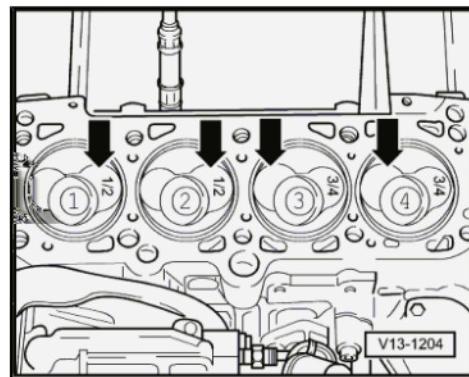
Piston - piston/cylinder installation position

Piston in cylinders 1 and 2:

Large seat for intake valve facing the flywheel side-arrows-

Piston in cylinders 3 and 4:

Large seat for intake valve facing the pulley side-arrows-

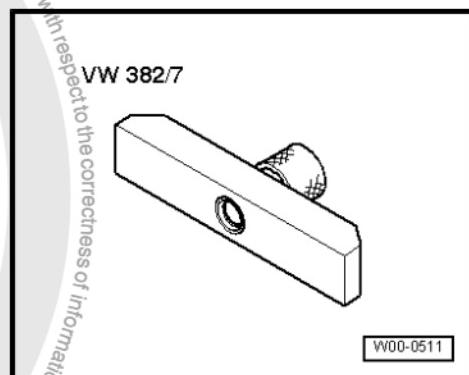
**Note**

- ◆ In new pistons, the cylinder position is marked by colors on the piston head.
- ◆ Piston for cylinders 1 and 2: Marking 1/2.
- ◆ Piston for cylinders 3 and 4: Marking 3/4.

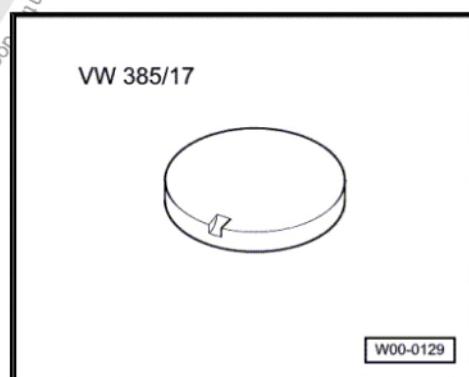
4.1 Piston protrusion - check

Special tools and workshop equipment required

◆ Measuring bridge -VW 382/7-



◆ Measuring disc -VW 385/17-



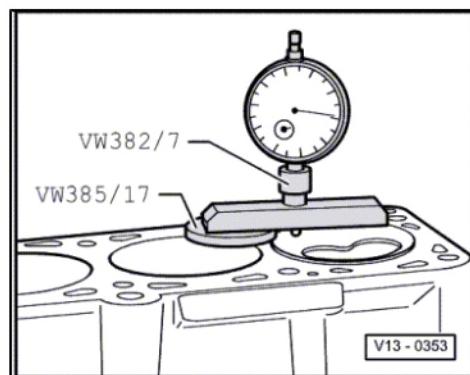
◆ Comparator



4.1.1 Checking sequence

When installing new pistons or an engine part, check the piston protrusion. According to the measure, it shall be installed the corresponding head sealing, as per the table below:

Piston protrusion	Identification: Notches/Holes
0,91 mm ... 1,00 mm.	1
1,01 mm... 1,10 mm.	2
1,11 mm... 1,20 mm.	3



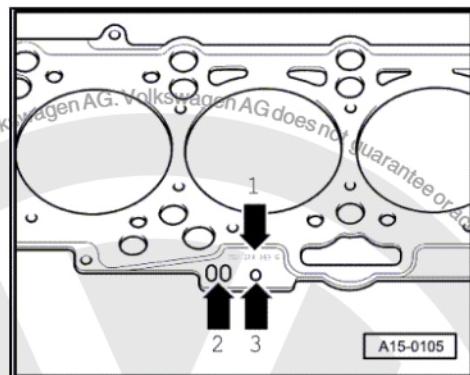
4.1.2 Cylinder head gasket identification

- ◆ Replacement part number = -arrow 1-
- ◆ Tax code = -arrow 2- (irrelevant!)
- ◆ Holes = -arrow 3-



Note

If different values are found when measuring the protrusion, the largest measure must be assigned to the gasket.



4.2 Piston and cylinder dimensions

Wear measure	Piston-Ø	Cylinder interior-Ø
Basic measure	mm 79,47	79,51
Grinding I	mm 79,72	79,76
Grinding II	mm 79,97	80,01



15 – Cylinder head, valve control mechanism

1 Cylinder head - disassemble and assemble

Check compression [page 48](#).



Note

- ◆ When installing a refurbished head with the camshaft installed, all contact surfaces between tappets and cams must be lubricated before installing the head cover.
- ◆ The plastic shims included for open valve protection should only be removed immediately before installing the cylinder head.
- ◆ When replacing cylinder head, the coolant should be totally replaced too.



WARNING

Always replace self-locking nuts and screws subject to angular torque





1 - Cylinder head seal gasket

- Replace.
- Observe identification
[⇒ page 35](#)
- After replacing, replace coolant completely.

2 - 20 Nm

3 - Engine cylinder head

- Check bending
[⇒ page 35](#)
- Remove and install
[⇒ page 42](#).
- After replacing, replace coolant completely.

4 - Suspension support

5 - 8 Nm

- To engine cover.
- Not applicable.

6 - Cylinder head fastening screw

- Replace after each removal.
- Observe the installation and removal sequence
[⇒ page 42](#).

7 - Oil deflector

8 - Cylinder head cover

- With vulcanised seal.

9 - Sealing ring

- Replace when damaged.

10 - Oil supply cover

- Replace the gasket, if damaged.

11 - Crankcase ventilation hose

12 - Clamp

13 - Crankcase ventilation valve

- For crankcase ventilation.

14 - Sealing

- Replace when damaged.

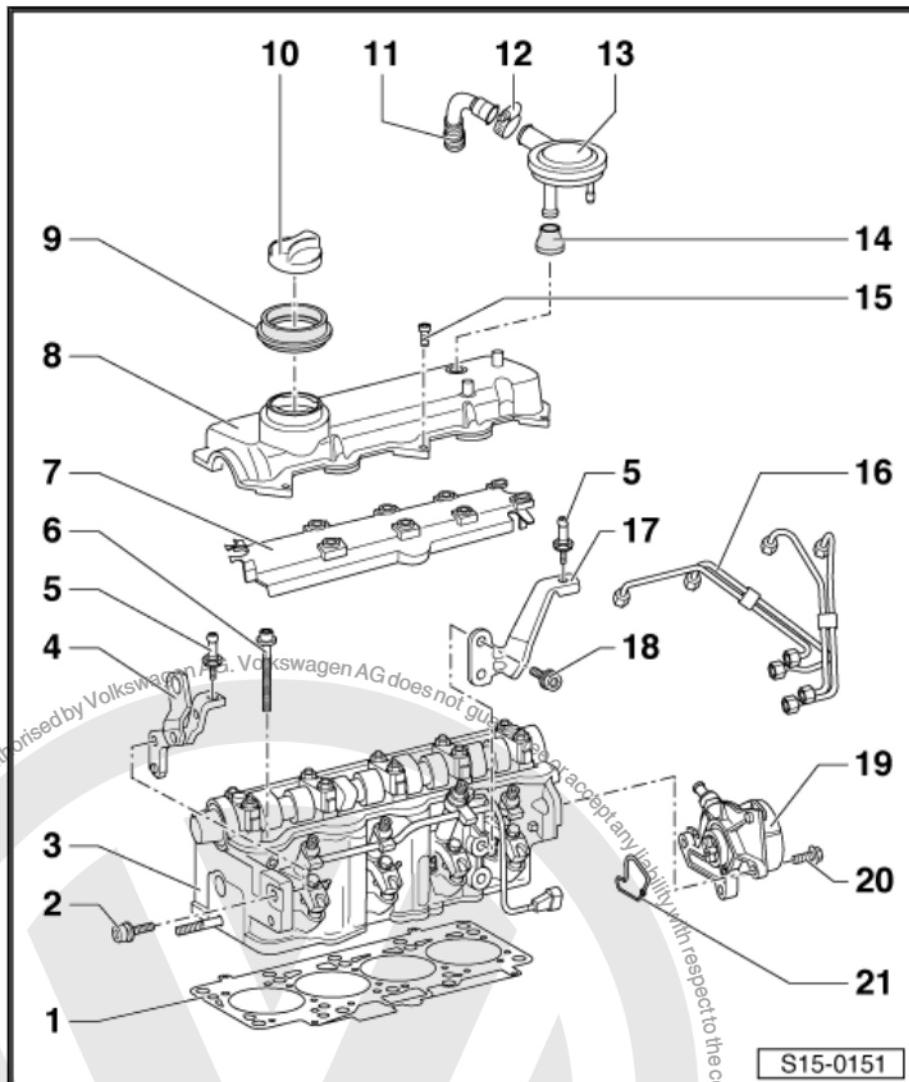
15 - 10 Nm

16 - Injection tubing

- Tighten screw with 25 Nm.
- Remove with Open star wrench -3035- .
- Always remove the complete set.
- Do not change the curved shape.

17 - Support

- To engine cover.
- Not applicable.



S15-0151



18 - 20 Nm

19 - Vacuum pump

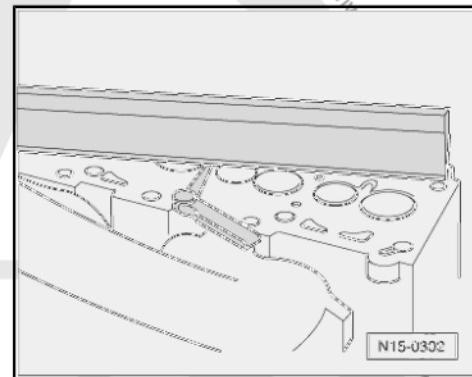
- To the servo brake.

20 - 20 Nm

21 - Gasket

- Replace.

Head - check bending



Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Auxiliary ruler

Checking sequence

Max. permissible bending: 0.1 mm.

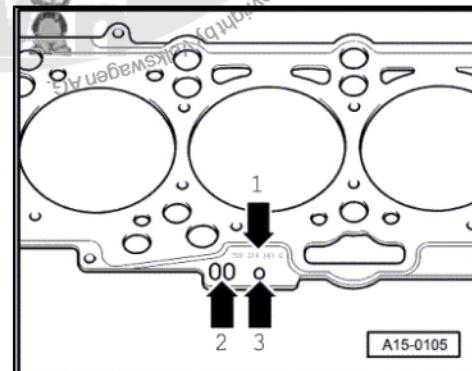


Note

Diesel engine head rework is not permitted.

Cylinder head gasket - identification

- ◆ Replacement part number = -arrow 1-
- ◆ Tax code = -arrow 2- (irrelevant!)
- ◆ Holes = -arrow 3-



Note

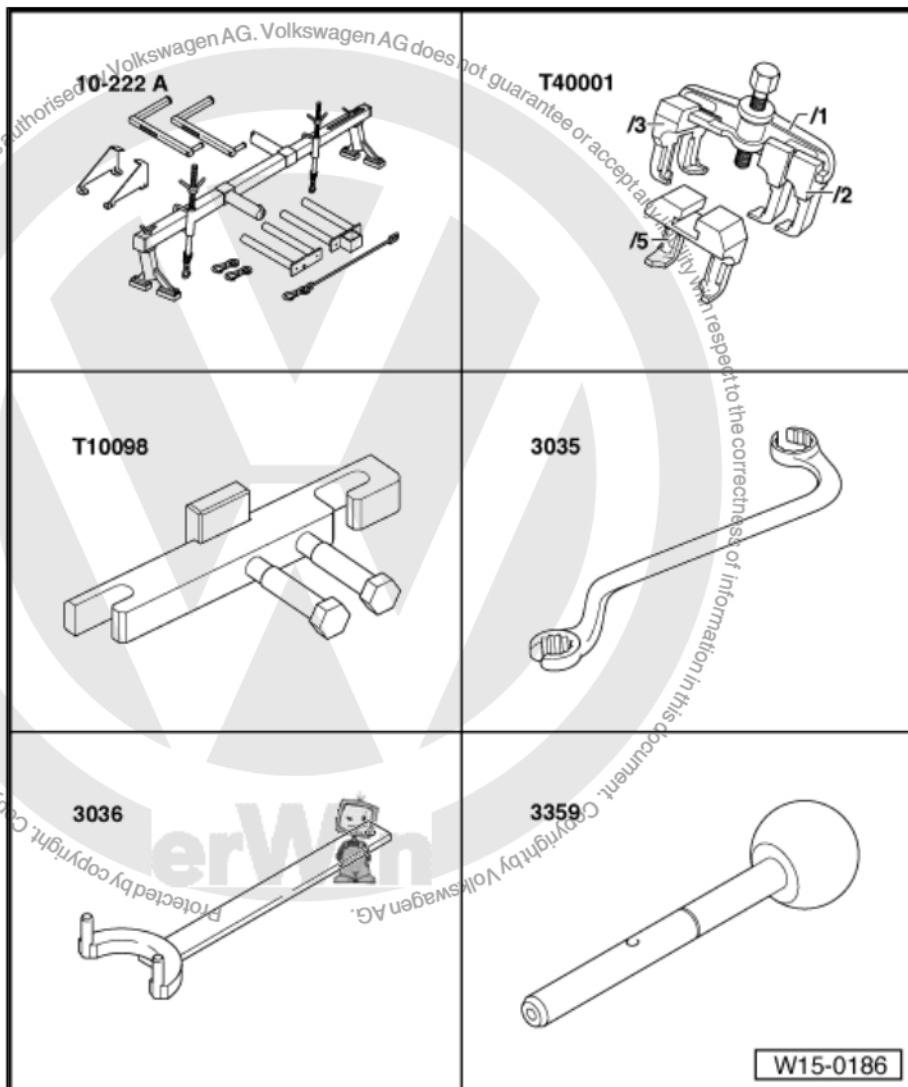
Gaskets with different thicknesses may be installed according to the piston protrusion. When replacing the gasket, install another part with equal identification.



1.1 Toothed belt - remove and install, adjust

Special tools and workshop equipment required

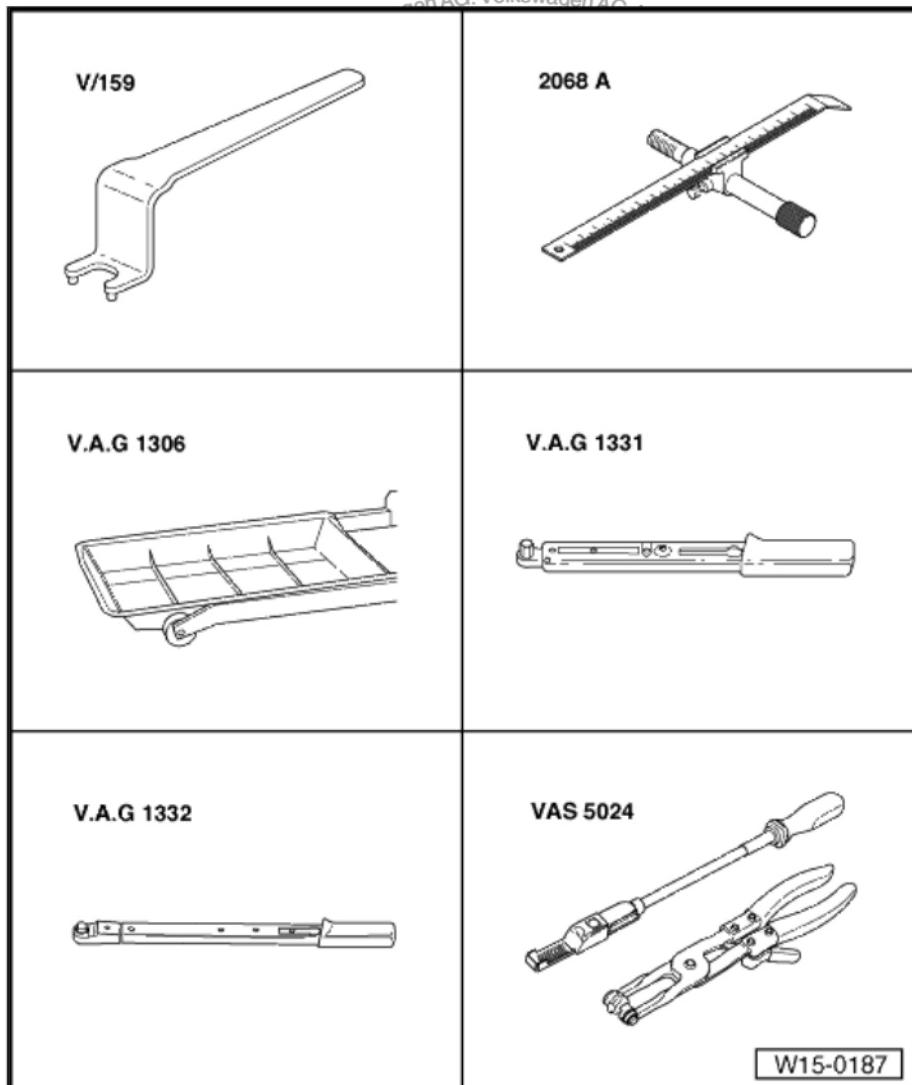
- ◆ Support device -10- 222A - with feet -10- 222A/1-
- ◆ Puller -T 40001-
- ◆ Alignment bar -T 10098A-
- ◆ Special wrench -3036-
- ◆ Lock pin -3359-
- ◆ Wrench -V 159-



W15-0186

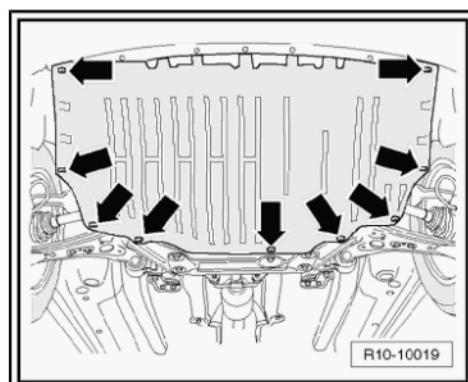


- ◆ Top dead centre adjustment device -2068 A-
- ◆ Oil collecting tray -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Torque wrench - 40 to 200 Nm (enc. 1/2") -VAG 1332-
- ◆ VW 5162 or Standard type clamp pliers -VAS 5024A-



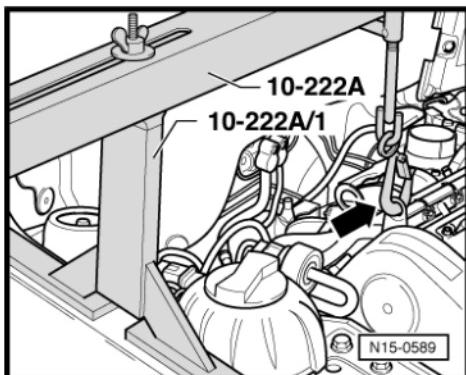
1.1.1 Removal

- Remove the Poly-V belt [= page 15](#).
- Remove the upper mechanical distribution cover.
- Remove the vacuum pump for servo brake .
- Remove the lower noise insulation from the engine.





- Place the Support -VW 061 (VWB) - ou - 10-222A - as illustrated and support the engine in the assembly position.
- Slightly raise the engine.

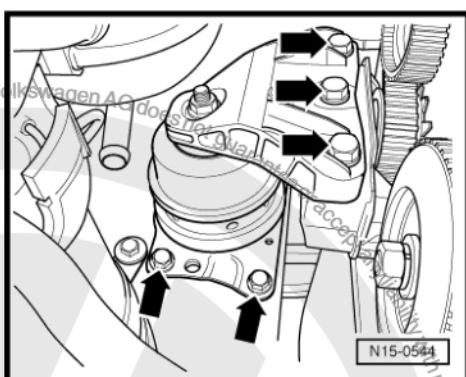


- Loosen the fastening screws of the powerdrive group support, engine, transmission, subframe/body support -arrows- and fully remove the assembly support.
- Remove the upper mechanical distribution cover.

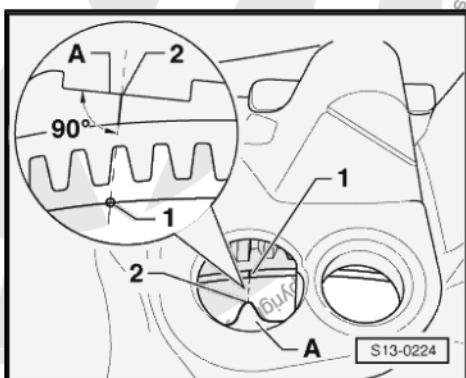


Note

- ◆ *The powerdrive group and engine support can be removed only when the engine is anchored with the Support -VW 061 (VWB) - ou - 10-222A- !*
- ◆ *The engine support can only be released when the powerdrive group and engine support is removed.*
- ◆ *To loosen the screw of the powerdrive group and engine support, lift the engine with the Support -VW 061 (VWB) - ou - 10-222A- .*

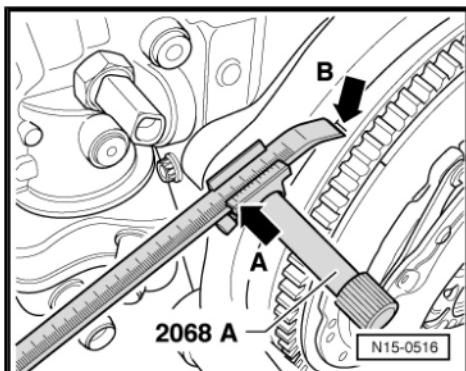


- Install the engine support on the engine block.
- Turn the crankcase to OT cylinder 1.
- The flywheel marking -1- must be aligned with the transmission marking -2-.



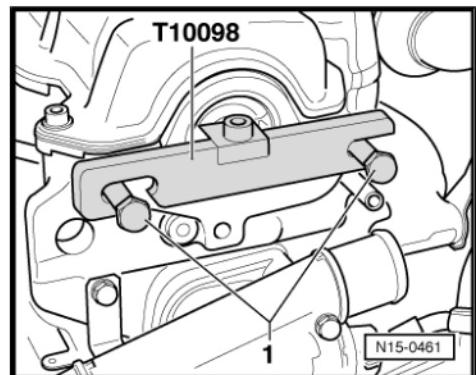
Note

- ◆ *Observe the milled surface of transmission -A- perpendicularly to the flywheel marking.*
- ◆ *With the engine removed:*
- ◆ *Install the Top dead centre adjustment device -2068 A- , as shown.*
- ◆ *Adjust the Top dead centre adjustment device -2068 A- to 120 mm. Left bevel of Vernier scale is the -arrow A- reference point*
- ◆ *Turn crankshaft until OT marking on flywheel is aligned with the adjustment device -arrow B- tip*

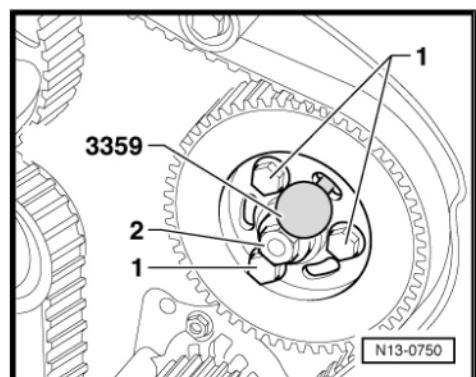




- Manually install the adjustment screws -1- to the stop.
- Lock the camshaft as shown with the Alignment bar -T 10098A- .



- Lock injector pump gear with Locking pin -3359- .
- Loosen screws -1- of the injector pump gear.
- Remove mechanical distribution lower cover.
- Remove the pulley/vibration damper.
- Mark the toothed belt operation direction.
- Loosen the tensioning pulley.
- Remove the toothed belt.



1.1.2 Installation

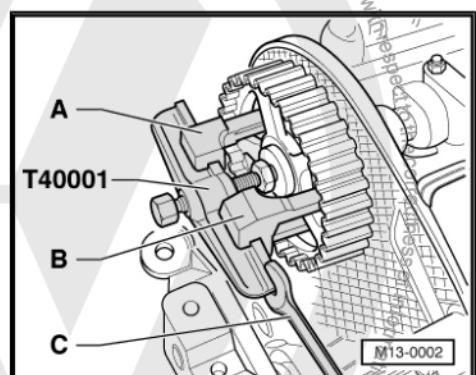
- Check if the OT marking on the flywheel aligns with the reference mark.
- Loosen the camshaft gear screw by one turn. To loosen the screw, immobilise the camshaft gear with the Special wrench -3036 - .



Note

To loosen and tighten the camshaft gear, never use the Alignment bar -T 10098A- as immobilising element! Use the Special wrench -3036- .

- Place the Puller -T 40001- with the Single arm claw -T40001/2--A- and the 2-arm claw -T40001/3--B- centred on the camshaft gear, and pull. Use a fixed wrench -C- as support.
- Install the toothed belt on the crankshaft gear, pulley, injector pump gear, water pump gear and tensioning pulley (observe rotation direction).
- Centre the injector pump gear into the elongated holes.
- Install the camshaft gear with the toothed belt and fasten with fastening screw (camshaft gear still remains movable).





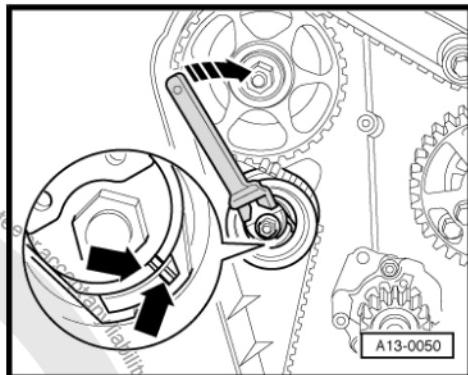
- Adjust the toothed belt. To do so, turn the Wrench -V 159- on the cam clockwise until matching the notch and elevation -arrows-.



Note

If the cam was excessively advanced, the tensioning pulley must be loosened and readjusted. The cam cannot be corrected with excessive turn advance.

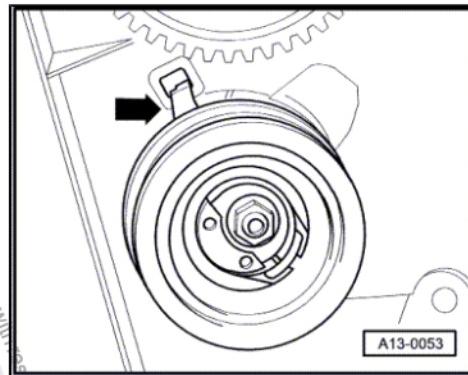
- Tighten the locknut on the tensioning pulley. Tightening torque: 25 Nm.
- Check again if the OT marking on the flywheel aligns with the reference mark.





Note

- ◆ Pay attention to the correct seating of the fastening device -arrow- of the tensioning pulley, which must fit into the mechanical distribution rear cover slot.
- ◆
- Check again the OT marking on flywheel.
- Tighten the fastening screw used for the camshaft gear. Tightening torque: 45 Nm.
- Tighten the fastening screw in the camshaft gear. Tightening torque: 25 Nm
- Remove the Alignment bar -T 10098A- .
- Remove the Locking pin -3359- .
- Rotate the crankshaft by two turns towards the engine operation direction until replacing the crankshaft in OT for cylinder 1.
- Check if the OT marking on flywheel, adjusting ruler on cam-shaft and the Locking pin -3359- fit on the injector pump gear to adjust the tensioning pulley (Slot/shoulder).
- If the slot and shoulder or slot -arrow- are not juxtaposed, adjust tensioning pulley and tighten nut to 25 Nm.
- Rotate the crankshaft by two turns towards the engine operation direction until replacing the crankshaft in OT for cylinder 1.
- Repeat the test.
- Install the engine support on the engine block. Tightening torque 45 Nm.



Note

Before installing the subframe, all the screws of the engine support must be tightened with the determined torque.

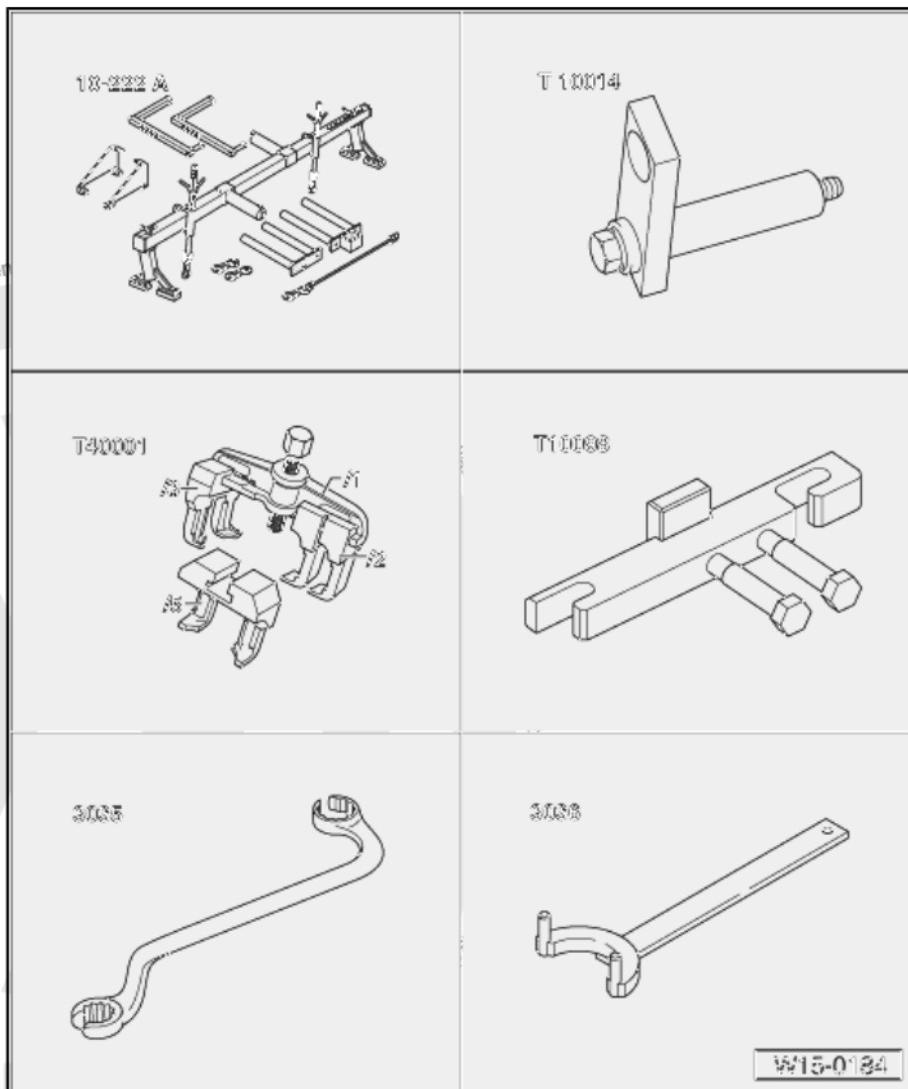
- Install power-drive group support, engine Tightening torque [⇒ page 8](#) .
- Install vacuum pump.
- Install mechanical distribution cover and pulley/vibration damper of crankshaft.
- Install Poly-V belt [⇒ page 15](#) .
- Install the engine noise insulation .
- Install mechanical distribution upper cover.
- Perform a test drive and check fault memory [⇒ page 107](#) .
- Check the injection start dynamically, and occasionally, adjust functions and components [⇒ page 108](#) .



1.2 Cylinder head - remove and install

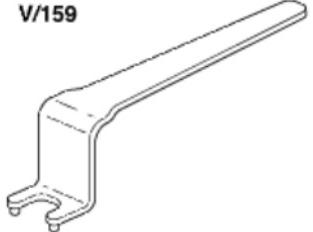
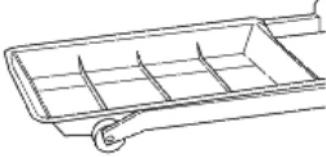
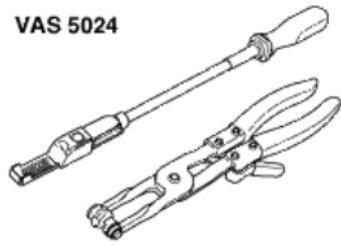
Special tools and workshop equipment required

- ◆ Support or VW 061-10-222A-
- ◆ Support -T 10014-
- ◆ Puller -T 40001-
- ◆ Alignment bar -T 10098A-
- ◆ Open star wrench -3035-
- ◆ Special wrench -3036-
- ◆ Lock pins -3359-





- ◆ Wrench -V 159-
- ◆ Oil collecting tray -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Torque wrench - 40 to 200 Nm (enc. 1/2") -VAG 1332-
- ◆ VW 5162 or Standart type clamp pliers -VAS 5024A-

 3359	 V/159
 V.A.G 1306	 V.A.G 1331
 V.A.G 1332	 VAS 5024

W15-0185

1.2.1 Conditions

- The engine cannot be any hotter than hand touching temperature.
- No piston should be in top dead centre position.

1.2.2 Removal



Note

During the work sequence, the Battery -A- earth strap will have to be disconnected. Therefore, check first whether a code radio is installed. If so, first obtain the anti-theft system code.

- With the ignition switched off, disconnect the Battery -A- earth strap.
- All the cable ties loosened or cut to remove the engine must be reinstalled at the same points upon installation.



- Remove the lower noise insulation from the engine.
- Remove the front part of the exhaust tube with the catalytic converter [page 110](#).
- Drain the cooling system [page 75](#).
- Remove the injector tubing set.

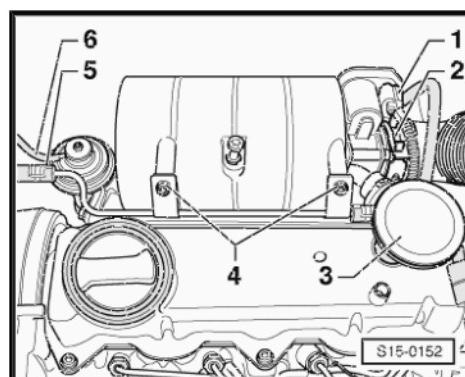
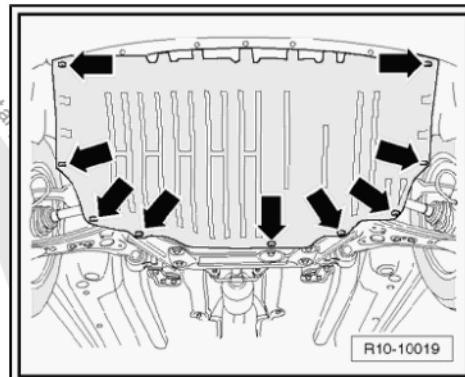
**Note**

◆ To loosen the injection tubes, use the Open star wrench -3035-.

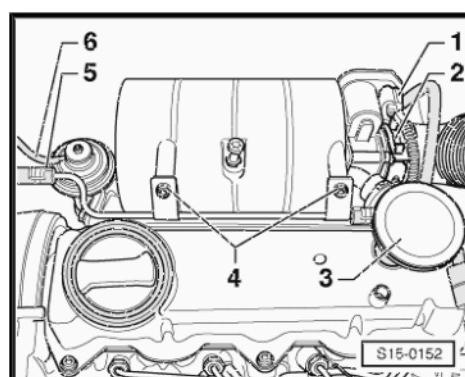
◆ Always remove the complete set of tubes.

◆ Do not change the curved shape.

- Cover openings with a clean cloth.
- Disconnect the return tubes from the injectors/injector pump.
- Disconnect the connection bar from the pre-heating plugs.
- Remove vacuum tubes on cylinder head.
- Disconnect and loosen the remaining electrical connectors from the cylinder head.
- Remove the connector to the intake tube door -1-.
- Remove the suction tube of door -2- on the suction tube.
- Remove the venting valve from crankcase -3- with relief tube connected.

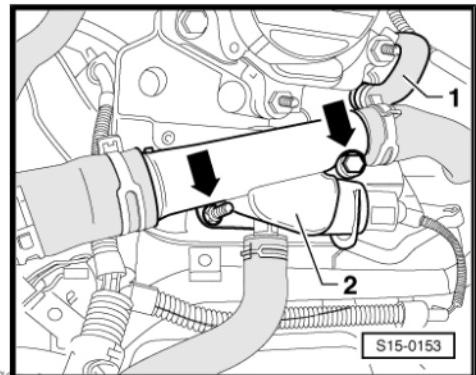


- Loosen the screws -4- in the intake tube.
- Disconnect the cooling system hose -5- and the vacuum hose-6-.





- Release the cooling system connection sleeve -2- -arrows- and separate the cooling system hose -1- in the distribution part.
- Remove the upper cover of the mechanical distribution and the cylinder head cover.
- Remove the vacuum pump for servo brake.



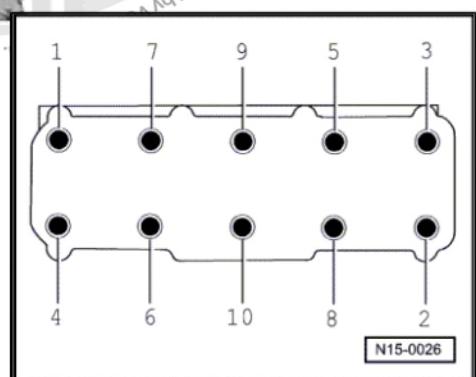
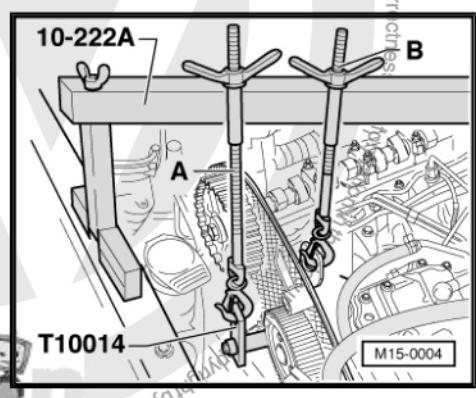
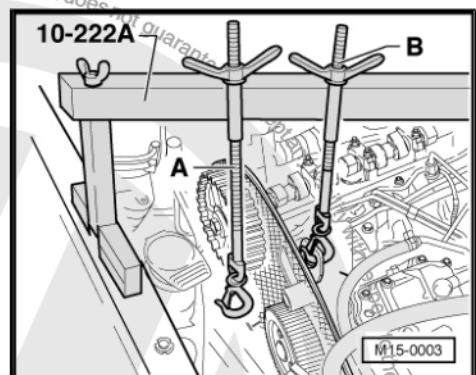
- Install the Support or VW 061 -10-222A- and support the engine with the supporting spindle -B- at the installation position.



Note

Both suspension supports are on the cylinder head. Thus, a third support must be placed for supporting engine on the block.

- Remove the Poly-V belt [page 15](#).
- Remove the camshaft gear toothed belt [page 36](#).
- Remove the engine support in the block [page 36](#).
- Install the Support -T 10014- in the front hole of the engine support, over water pump.
- By using the second spindle, -A- lift the engine until releasing the spindle -B-.
- Remove the toothed belt tensioning pulley.
- Remove the screws for the mechanical distribution cover, behind the cylinder head.
- Loosen and remove the cylinder head screws in the indicated order.
- Remove the engine cylinder head carefully.



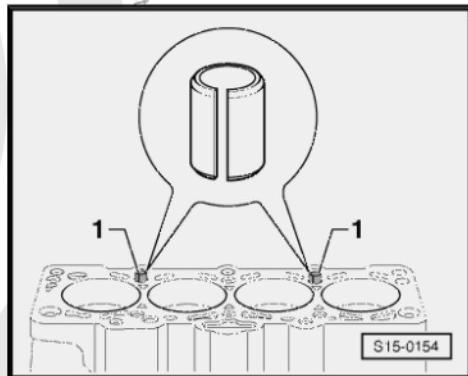


1.2.3 Installation



Note

- ◆ Always change the cylinder head screws.
 - ◆ In case of repair, carefully remove the gasket remains between the cylinder head and crankcase. Pay attention in order not to produce scratches. When using the sandpaper, do not use grade less than 100.
 - ◆ Remove carefully the remaining residues from sanding operations.
 - ◆ The new cylinder head gasket must only be removed from package immediately before its installation.
 - ◆ Handle the new gasket with extreme care. Damages on the groove region will cause leaks.
- Fill the cylinders with clean cloths to prevent any dirt or material remains from entering the region between the internal cylinder walls and pistons.
- Also prevent any dirt or material residues from entering into the cooling system.
- Remove carefully the remaining residues from sanding operations and remove cloths.
- Check if both adjustment bushings -1- for cylinder head alignment area installed.
- Before adjusting the cylinder head, place the crankshaft at the OT marking.
- Turn the crankcase anti-clockwise until all the pistons are equally at OT position.
- Install the cylinder head gasket.
- Install the engine cylinder head, insert the other screws and tighten by hand.



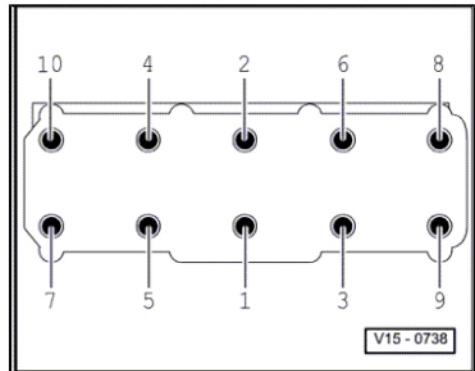


- Tighten cylinder head screws in four stages, in the following sequence:
- 1. Apply prior tightening to the torques: Stage I = 40 Nm Stage II = 60 Nm
- 2. Proceed turning with fixed wrench: Stage III = 90° Stage IV = 90°



Note

Retightening of cylinder head screws is not required after repairs.



Install in reverse order from the removal.

- After fastening the cylinder head, turn camshaft in order that the cylinder 1 cams indicate equally upwards. Before installing the toothed belt, place crankshaft in OT, following engine rotation. *****julia*****
- Place the camshaft gear with the toothed belt and fasten with screw (camshaft gear still remains movable).

When the toothed belt is installed and ignition times are adjusted
[⇒ page 36](#).

- Remove the engine support in the block [⇒ page 36](#). Torque: 45 Nm.



Note

Before installing subframe, all the screws of the engine support must be tightened to the torque determined.

- Install vacuum pump.
- Install the front part of the exhaust tube with catalytic converter
[⇒ page 110](#).

Replenish the cooling system with new coolant [⇒ page 75](#).

- Perform test run and check fault memory [⇒ page 107](#).

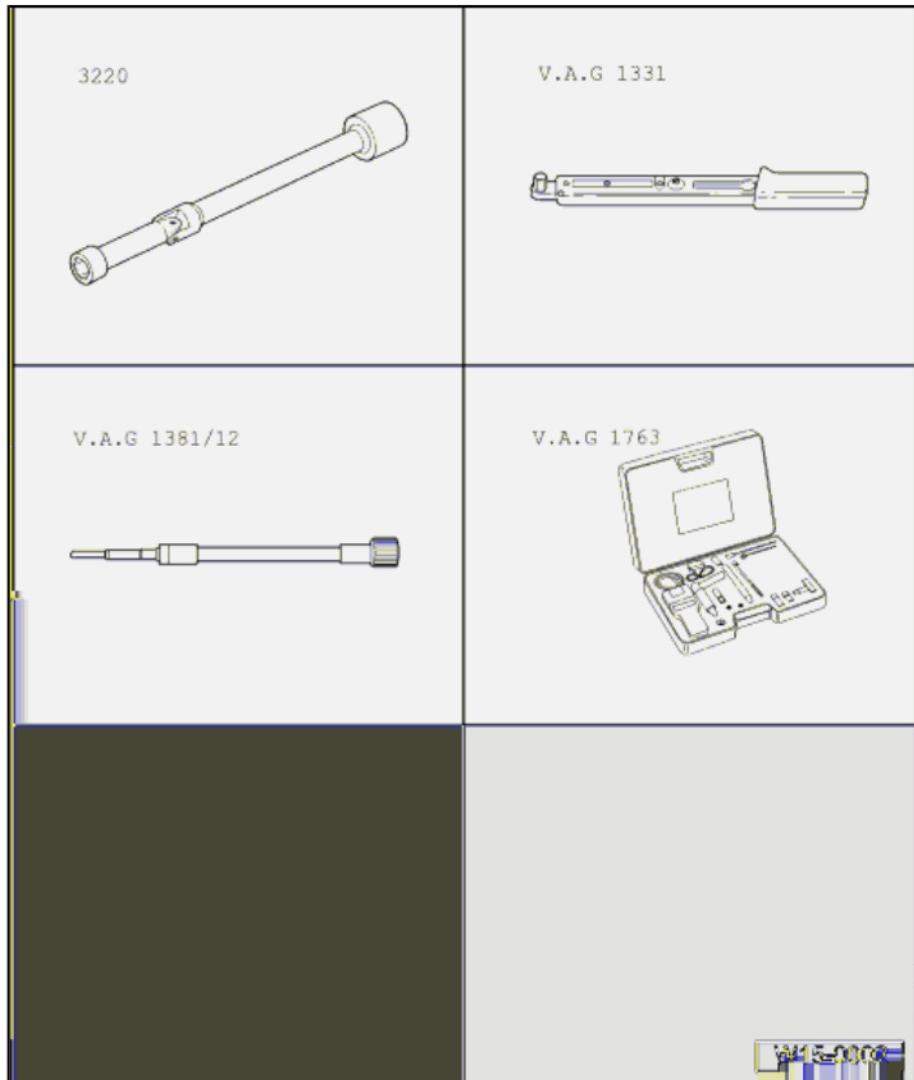




1.3 Compression - check

Special tools and workshop equipment required

- ◆ U/J extension and socket, 10 mm -3220-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Adapter for VAG 1763 - VAG 1381/12-
- ◆ Cylinder compression meter - gasoline/alcohol -VAG 1763-



1.3.1 Checking conditions

- Minimum oil temperature 86 °F.

1.3.2 Checking sequence

- Disengage the 10-pole connector of the injector pump.
- Remove all the pre-heating plugs, using U/J extension and socket, 10 mm -3220- .



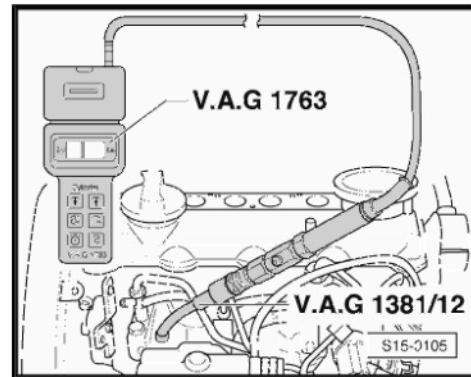
- Screw the Adapter for VAG 1763 -VAG 1381/12- in the plug sockets.
- Check compression with the compression meter - V.A.G 1381- .



Note

Handling the compression meter ? Usage instructions supplied with the equipment.

- Turn the starter on until the compression meter stops indicating pressure increase.



Compression values:

Engine prefix	ASY	
Cylinder compression	bar	25,0 to 31,0
Wear limit	bar	19,0
Maximum compression difference between cylinders	bar	5,0

- Install the pre-heating plugs, using the U/J extension with 10 mm socket -3220-. Tightening torque: 15 Nm.
- Perform test run and check fault memory [⇒ page 107](#) .



Note

Faults are saved in memory when the injector pump fittings are opened. Thus, refer to the fault memory and clear these fault indications.



2 Valve command - repair



Note

- ◆ Cylinder heads with cracks between the valve seats can still be used without reducing their useful life when such cracks are small, maximum 0.5 mm wide.
- ◆ Before performing assembly works, it is necessary to lubricate support and sliding surfaces.

1 - Bearing caps

- Installation position
[⇒ page 51](#)
- Observe the installation and removal sequence
[⇒ page 57](#).
- Apply Sealing putty - AMV 174 004 01- on the supporting surface of bearing 1 cap.

2 - 20 Nm

3 - Camshaft

- Check axial clearance
[⇒ page 19](#)
- Remove and install
[⇒ page 57](#).
- Measure radial clearance with "Plastigage": Wear limit: 0.11 mm.
- Eccentricity: max. 0.05 mm.
- Distribution times for 1-mm valve clearance
[⇒ page 52](#)

4 - Hydraulic tappet

- Check camshaft axial clearance before installing [⇒ page 19](#)
- Check [⇒ page 60](#).
- Do not change position.
- With valve clearance hydraulic offsetting.
- Upon removal, support with the upper part facing downwards.
- Lubricate contact surfaces.

5 - Keys

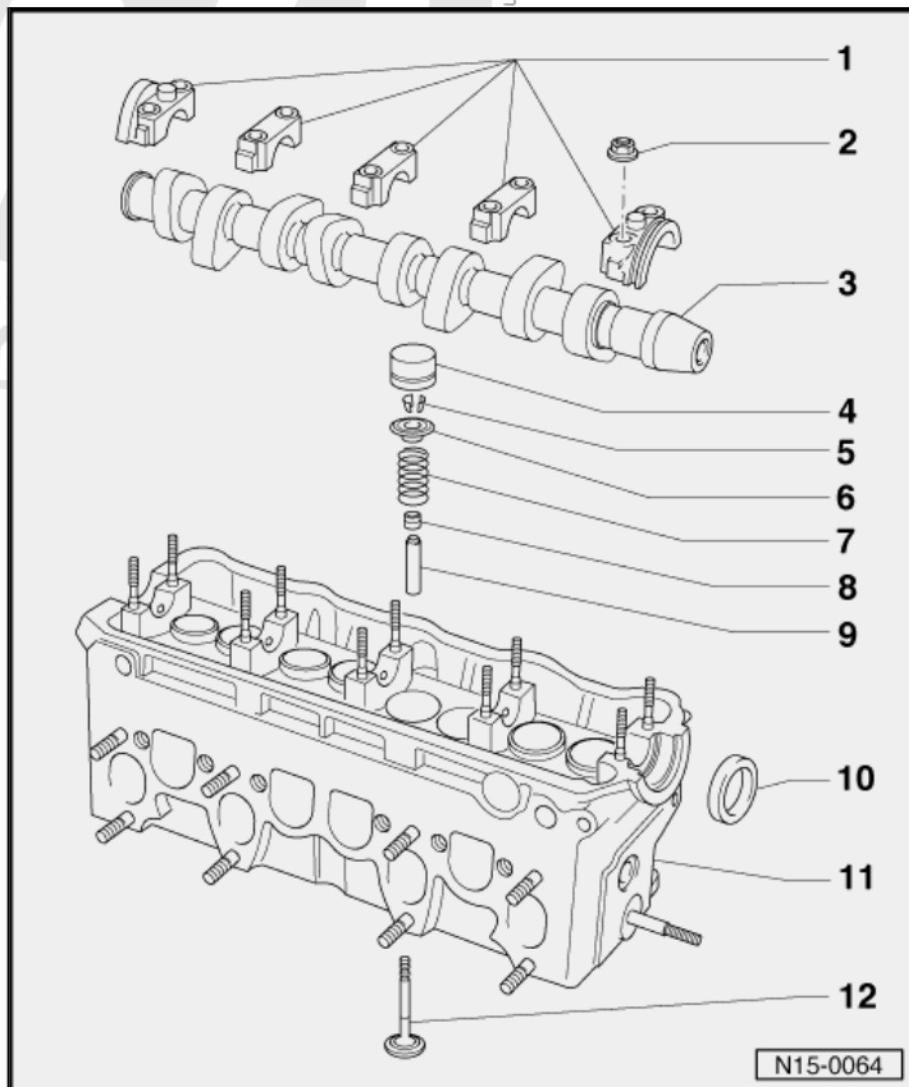
6 - Spring dish

7 - Valve spring

- Cylinder head - remove and install. Remove with the Compressor device -2037- mounted:
[⇒ page 55](#).

8 - Valve stem seal

- Replace [⇒ page 55](#).





9 - Valve guide

- Check [page 54](#).

10 - Seal

- Do not lubricate or grease on the seal lip.
- Remove and install the toothed belt, adjust [page 36](#).
- Before installing, remove oil residues from the camshaft crankpin with a clean cloth.
- To install the fitting on the camshaft cone, secure with regular adhesive tape (e.g. Durex tape).

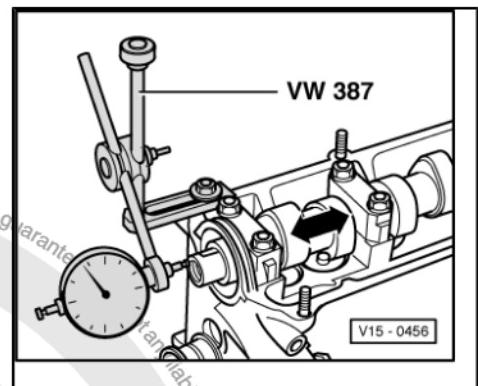
11 - Engine cylinder head

- Pay attention to the note [page 50](#).
- Valves Rework seats [page 52](#).

12 - Valves

- Valve measures [page 52](#)
- Do not grind; only seating is permitted.

Camshaft - check axial clearance



Special tools and workshop equipment required

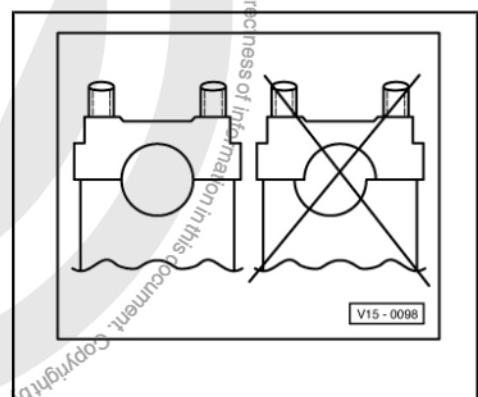
- ◆ Support -VW387-
- ◆ Dial gauge

Measure with tappets removed and the first and last bearing caps mounted.

Wear limit: max. 0.15 mm

Assembly position of the camshaft bearing cap

Observe runout: Before installing the camshaft, place bearing caps and check installation position.



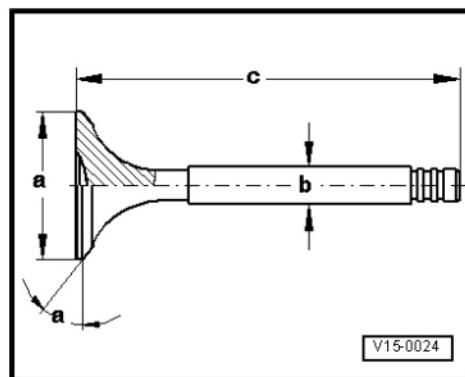


Valve dimensions



Valves cannot be ground. Only seating is permitted.

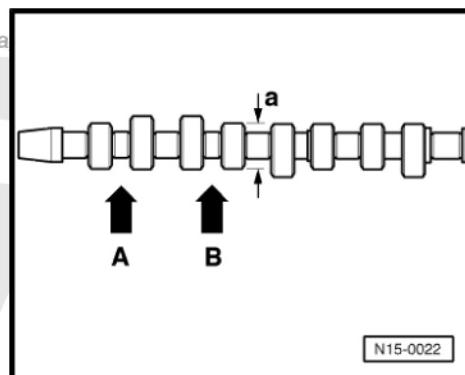
Measure	Intake valve	Exhaust valve
\varnothing a mm	35,95	31,45
\varnothing b mm	6,963	6,943
C mm	96,55	96,35
a ?°	45	45



Camshaft code

Identification:

- ◆ Cam base circles $a = \varnothing 38$ mm.
- ◆ Identification by numbers and letters engraved between intake and exhaust cams:



Cylinder 1 -arrow A-	38 E
Cylinder 2 -arrow B-	FL

Distribution times in 1-mm valve clearance

Intake opens after TDC	11,0° 12'
Intake closes after BDC	25°
Exhaust opens before BDC	40°
Exhaust closes after TDC	10°

2.1 Valve seat - grind

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat grinder

**Note**

- ◆ *Do not grind valves. Only seating is permitted.*
- ◆ *When repairing engines with non-leakproof, grinding and/or changing valve seats and valves only is not enough. Particularly in case of engines with more mileage, the valve guides must be checked for wear.*
- ◆ *Grind valve seats only until achieving perfect finish. Before proceeding with grinding, estimate the maximum grinding measure accepted. If the grinding measure is exceeded, hydraulic offsetting of valve clearance is no longer ensured and the engine cylinder head must be replaced.*

2.1.1 Sequence of operations

2.1.2 Estimating maximum grinding specification allowed:

- Install the valve and press it strongly against its seat.

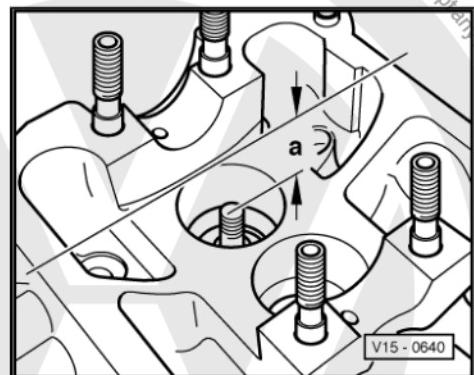
**Note**

In case the valve is replaced during repairs, use new valve for measurement.

- Measure the distance -a- between the valve stem end and the upper edge of the cylinder head.
- Calculate the maximum admissible grinding elevation from the distance measured -a- and the minimum elevation.

Minimum measurements: Intake valve 35.8 mm. Exhaust valve 36.1 mm.

Distance measured -a- minus minimum distance = max. grinding measure permissible.



2.1.3 For example:

-	Measured distance	36,5 mm
	Minimum measure	35,8 mm
=	Max. grinding measure permissible	0,7 mm

2.1.4 Grind intake valve seats

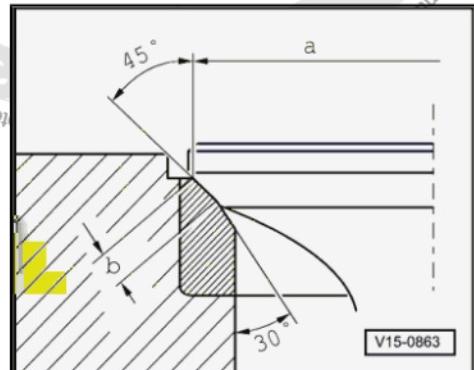
$$a = \varnothing 35.7 \text{ mm}$$

$$b = 1.6 \text{ mm}$$

$$45^\circ = \text{valve seating angle}$$

**Note**

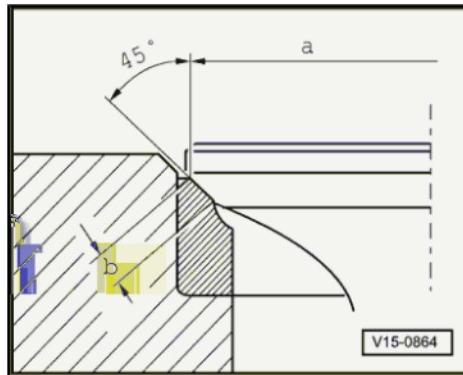
30° of lowering by milling the valve base is strictly necessary due to the hydrodynamic conditions of the intake duct.





2.1.5 Grind exhaust valve seat

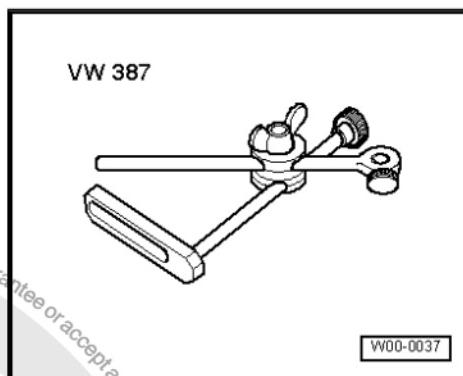
- a = Ø31.4 mm
b = 2.7 mm
45° = valve seating angle



2.2 Valve guides - check

Special tools and workshop equipment required

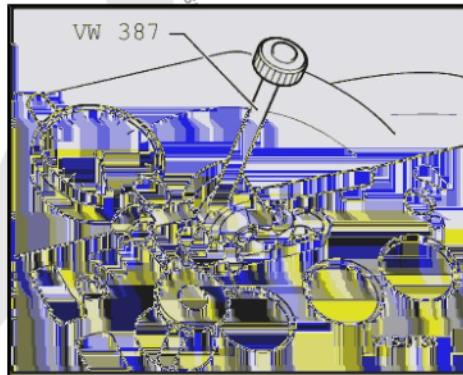
- ◆ Support -VW 387-



- ◆ Dial gauge

2.2.1 Checking sequence

- Place a new valve on the guide. Valve end shall be aligned with guide. Due to the various valve guide diameters, we recommend using only one intake valve on the intake guide and one exhaust valve on the escape guide.
- Measure tilting gap. Wear limit: 1.3 mm.
If the tilting gap is exceeded:
 - Replace engine cylinder head.

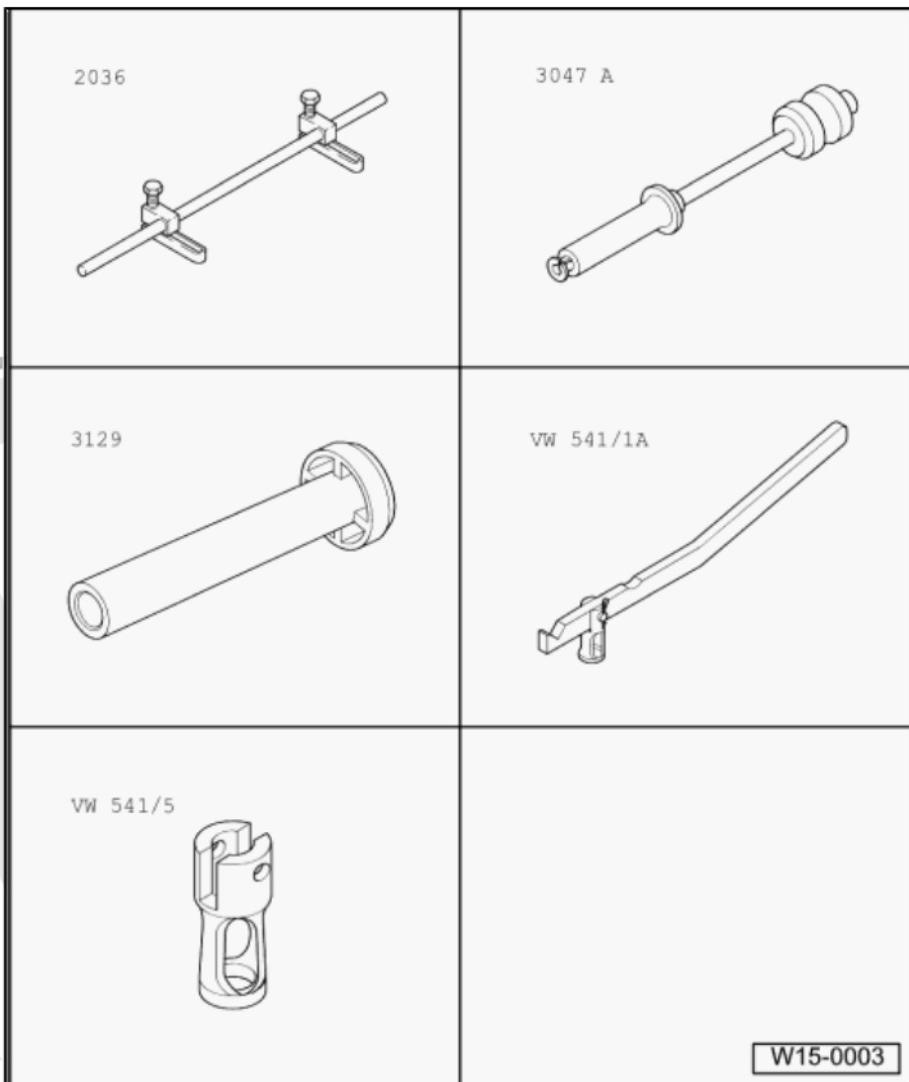




2.3 Valve stem seal - replace

Special tools and workshop equipment required

- ◆ Device -2036-
- ◆ Extractor or VW 5058 -3047A-
- ◆ Fitter -3129-
- ◆ Lever -VW 541/1A-
- ◆ Compressor -VW 541/50-



2.3.1 Removal

(with engine head installed)

- Remove camshaft [page 57](#).
- Remove hydraulic tappets and place them with contact surface turned downwards. Make sure the tappet positions are not changed.
- Place the piston of the respective cylinder at the "top dead centre" (OT) position.

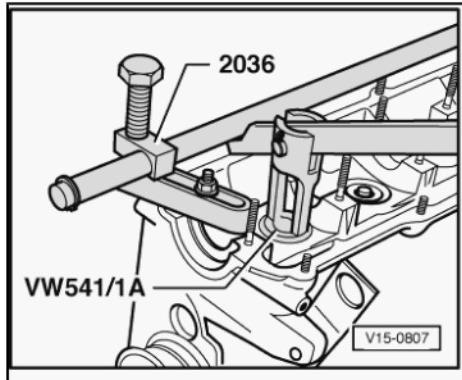


- Fit the Device -2036- and adjust bearings to height of stud screws.
- Remove valve springs with the Lever -VW 541/1A- and Compressor -VW 541/50- .

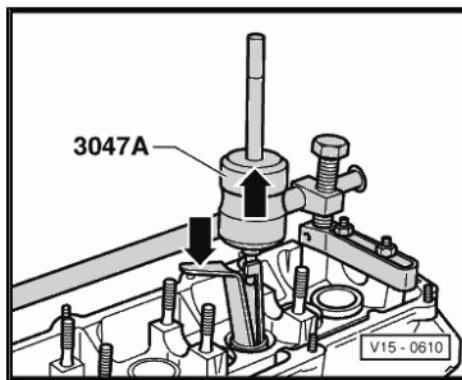


Note

By doing that, the valves remain supported on the piston head.

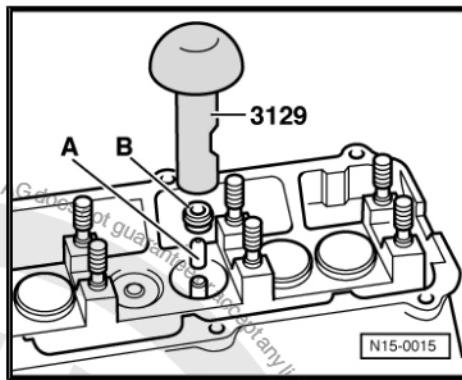


- Remove the valve stem seals with the Extractor or VW 5058 -3047A- .



2.3.2 Installation

- The plastic bushing -A- supplied must fit in the respective valve stem. This prevents damages on the valve stem -B- by the new seal.
- Install oil seal on the new valve stem by using the Fitter -3129- .
- Lubricate the sealing lip on the valve stem's oil seal and install it carefully in the guide.

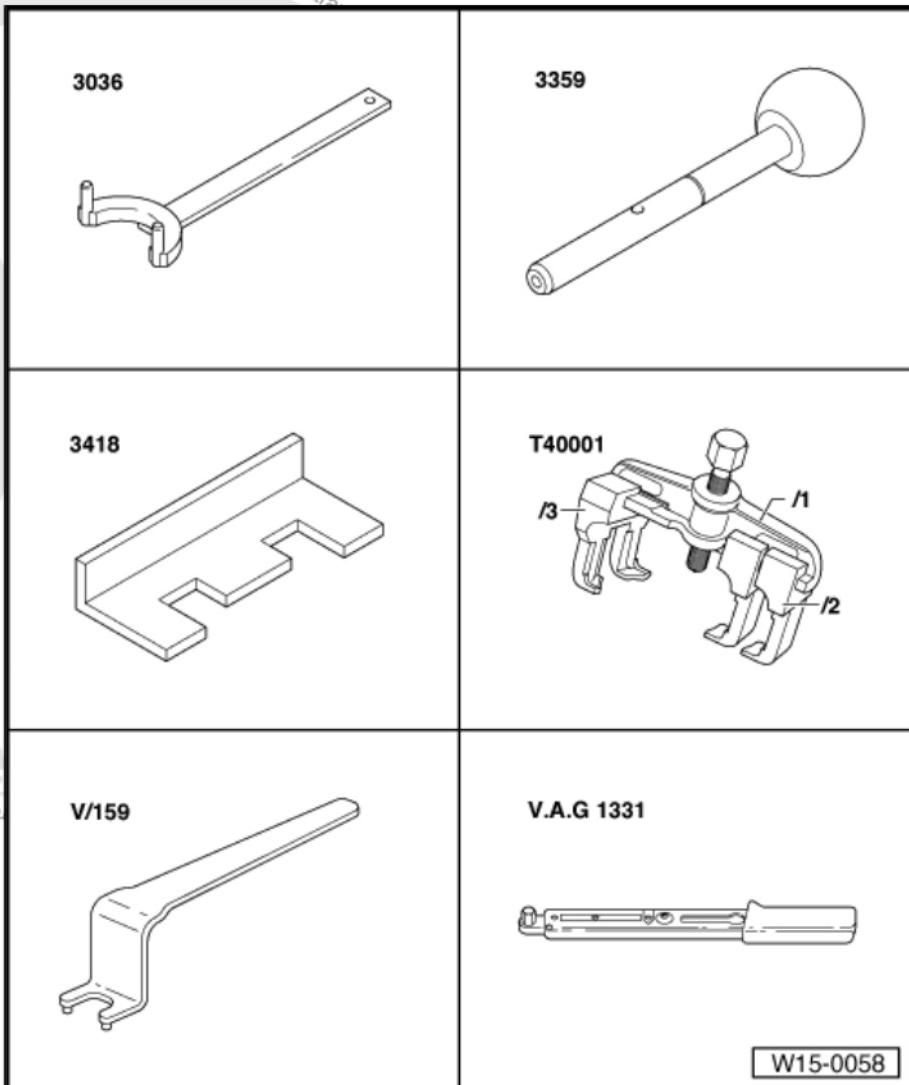




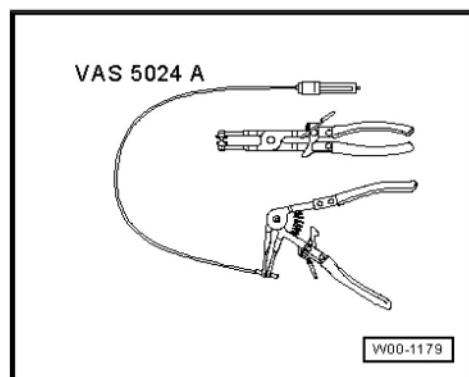
2.4 Camshaft - remove and install

Special tools and workshop equipment required

- ◆ Special wrench -3036-
- ◆ Lock pin -3359-
- ◆ Alignment bar -3418- or Alignment bar -T 10098A-
- ◆ Puller -T 40001-
- ◆ Wrench -V 159-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-



- ◆ VW 5162 or Standard type clamp pliers -VAS 5024A-



- ◆ Feeler gauge
- ◆ Sealing putty -AMV 174 004 01-



2.4.1 Removal

- Remove the upper cover of the mechanical distribution, the cylinder head cover and the vacuum pump.
- Remove the camshaft gear toothed belt [⇒ page 36](#).



Note

It is not necessary to remove the crankshaft pulley/vibration damper and the intermediate and lower cover of the mechanical distribution.

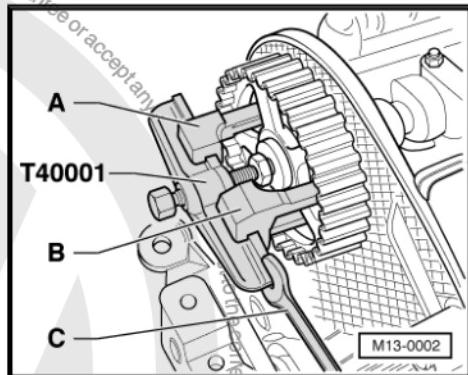
- Loosen the camshaft gear screw by one turn. To loosen the screw, immobilise the camshaft gear with the Special wrench -3036- .



Note

To loosen and tighten the camshaft gear, never use the Alignment bar -3418- or the Alignment bar -T 10098A as immobilising element! Use the Special wrench -3036-.

- Place the Puller -T 40001- with Single arm claw -T40001/2-A- and 2-arm claw -T40001/3-B- centred on the camshaft gear, and remove. Use a fixed wrench -C- as support.
- Remove camshaft gear.
- First, remove the bearing caps 5, 1 and 3. Then, loosen the bearing caps 2 and 4 alternately and in cross fashion.





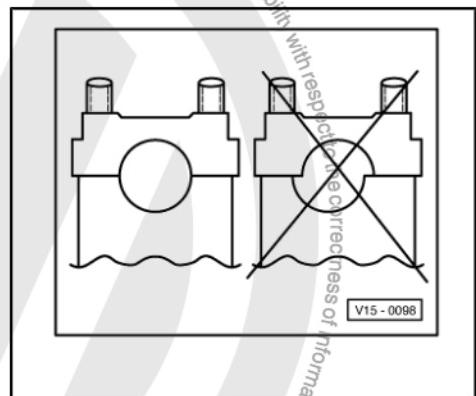
2.4.2 Installation



Note

- ◆ When installing the camshaft, the cams for cylinder 1 should point upwards.
- ◆ When installing the bearing caps, pay attention to the hole eccentricity. Before installing, place the bearing cap and check the correct installation position.

- Lubricate the camshaft contact surfaces.
- Place the camshaft in the head.
- Tighten bearing caps 2 and 4 alternately and in cross pattern, to 20 Nm.
- Lubricate slightly the supporting surface of bearings 1 and 5 with Sealing putty -AMV 174 004 01 - .
- Install bearing caps 5, 1 and 3, and tighten to 20 Nm.



Note

Remove the Sealing putty -AMV 174 004 01- excess from the bearing caps 1 and 5 on the cylinder head. No Sealing putty -AMV 174 004 01- residues must remain on the sealing surface of the cylinder head/cylinder head cover.

- Immobilise the camshaft as shown with the Alignment bar -3418- .
- Estimate average gap of the Alignment bar -3418- , as follows: Turn the locked camshaft until one end of the Alignment bar -3418- touches the cylinder head. Measure the gap at the other end of the Alignment bar -3418- with a gauge. Place the gauge with half of the measure of the gap found between the Alignment bar -3418- and cylinder head. Turn the camshaft until the Alignment bar -3418- touches the gauge. Insert another gauge with the same measure in the other end, between the adjusting Alignment bar -3418- and cylinder head.

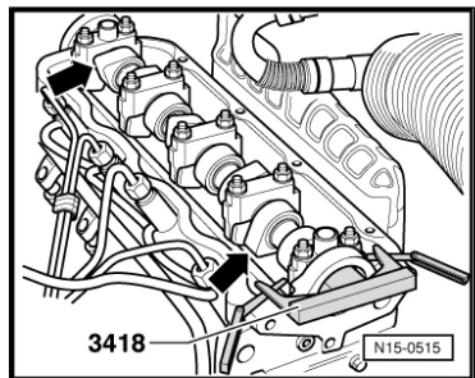


Note

The camshaft may also be locked with the Alignment bar -T 10098A- .

When the toothed belt is installed and distribution times are adjusted ➔ [page 36](#) .

- Install the upper cover of the mechanical distribution, cylinder head cover and vacuum pump.



Note

After installing the new hydraulic tappets, the engine must not run during approx. 30 minutes. The hydraulic compensation elements must seat (otherwise, valves will knock pistons).



2.5 Hydraulic tappets - check

Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden and/or plastic wedge



Note

- ◆ Change hydraulic tappets completely (they cannot be adjusted or repaired).
- ◆ Irregular valve noises during engine start are normal.

2.5.1 Checking conditions

- Minimum engine oil temperature 176 °F.

2.5.2 Checking sequence

- Start the engine and let it run until the Radiator fan -V7- starts its operation.
- Increase engine speed to 2500 rpm during 2 minutes.

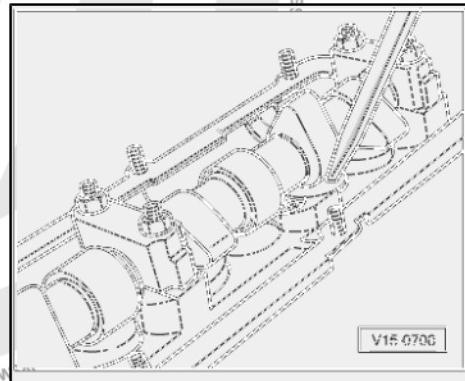
If the hydraulic tappets still produce noise, locate the damaged tappet, as follows:

- Remove the engine cylinder head lid.
- Turn crankshaft clockwise until the tappet drive cams to be checked are turned upwards.
- Measure the clearance between the cams and the tappets.
- If the clearance is greater than 0.1 mm, replace the tappet. If the gap is less than 0.1 mm, or if no gap is detected, proceed checking as follows:
- Press slightly the tappet downwards by using a wooden and/or plastic wedge. When this is possible, introduce a 0.1mm feeler gauge between camshaft and tappet, change tappet.



Note

After installing the new hydraulic tappets, the engine must not run during approx. 30 minutes. The hydraulic compensation elements must seat (otherwise, valves will knock pistons).





17 – Lubrication system

1 Lubrication system components - remove and install



Note

- ◆ *It is necessary to carefully clean the oil ducts, change the oil filter and oil radiator, if, when servicing the engine, significant amounts of metal particles and detached particles are found in the oil, due to abrasion or wear resulting from seizing (for instance, from the connecting rods or bearing shells). This procedure avoids damage.*
- ◆ *Oil level should not exceed the Max marking due to the risk of damage to the catalytic converter!*



WARNING

Always replace self-locking nuts and screws subject to angular torque

Check oil pressure [⇒ page 68](#).

Oil supply quantities:

with oil filter 4.3 l

Engine oil specification:

Only use engine oils according to -VW 505 00- or -VW 505 01- standards.

Part I - Assembly overview

Part II - Oil filter and support - disassembly and assembly
[⇒ page 61](#).





- With seal.
 - With Silicone seal for engine -D 176 404 A2 or A3- ⇒ page 23.
 - Remove and install
⇒ page 23.
 - Do not lubricate or grease on the seal lip.
 - Before installation, remove oil residues from crankshaft trunnion with clean cloth.
 - Replace the crankshaft seal (pulley side)
⇒ page 20.

3 - Chain tensioning element with tensioning rail, 15 Nm

- When installing, compress the spring and install.

4 - Gear

- #### Oil pump command.

5 - Oil dipstick

- Oil level must not exceed the Max. mark !
 - Marking \Rightarrow page 63

6. Funnel

- Remove to aspirate oil

7 - Guide tube

8 Oil injector

For me

- ### 25 N

5 - 25 NHT

- Install without seal.

10 - Sealing ring

Replace:

11 - Adjusting guide

12 - Suction tube

16 - Page 4

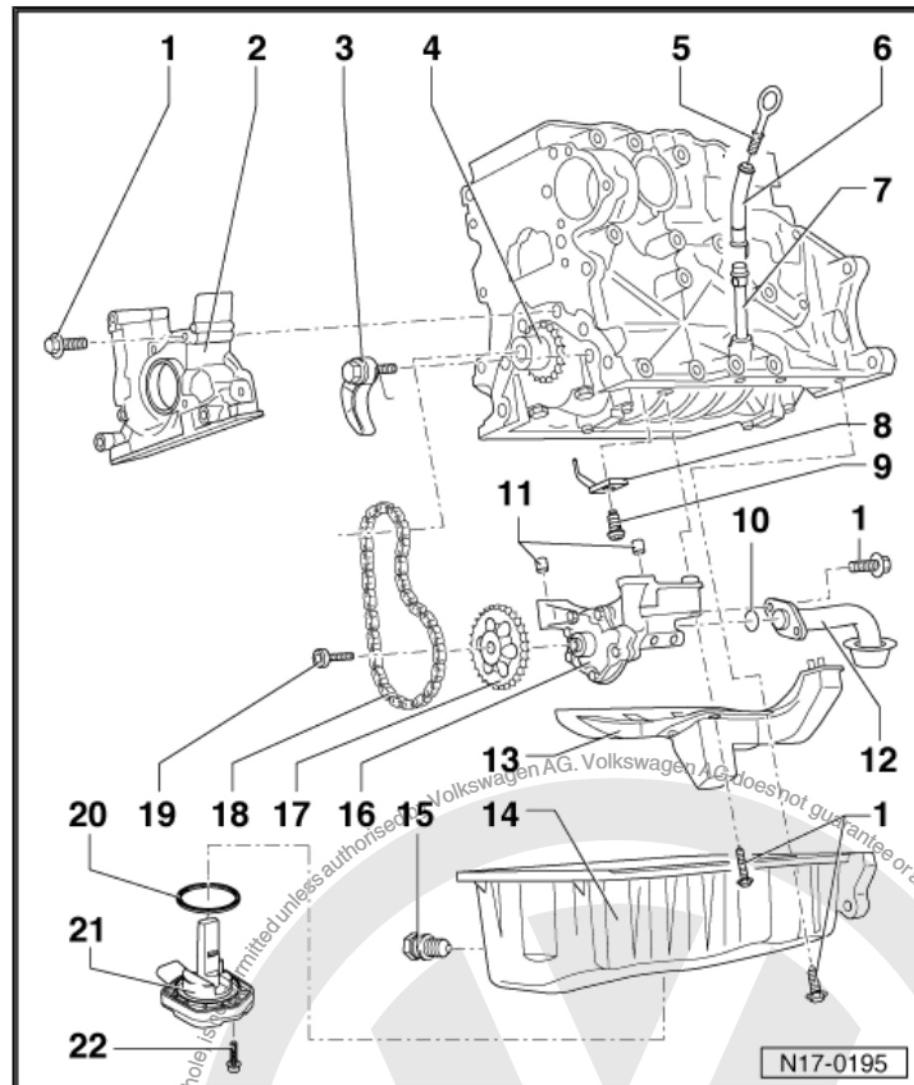
- 4 - Crankcase
 - Clean sealing surface before installation.
 - Remove and install → [page 65](#)

15. Oil draining plus 30 Nm

- In case of leakage, cut and replace the cooling ring.

16 Oil names

- With 12 bar overpressure valve.





Replace when splines are detected on the sliding surfaces and gears.

17 - Chain gear for oil pump

- Observe installation position.
- Only fits in one position.

18 - Chain

19 - 20 Nm + 90°

- Replace after each removal.

20 - Sealing ring

- Replace.

21 - Oil level and temperature sensor -G266-

- Not available.

22 - 10 Nm

Marks on oil dipstick

1 - max. mark

2 - min. marks

a - Region between the upper corner of the engraved region and the max. mark: do not replenish with oil.

b - Oil level in the marked field: May be filled with oil.

c - Region between min. mark and lower corner of marked area: Replenish with 0.5 l of engine oil.

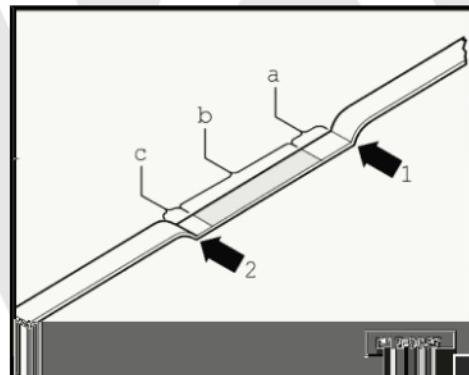
Part II

Oil filter and support - disassembly and assembly



WARNING

Always replace self-locking nuts and screws subject to angular torque





1 - Oil filter bracket

2 - 15 Nm + 90°

- Replace after each removal.
- First, turn the upper left and lower right screws until they touch the support, then tighten the four screws in cross fashion.

3 - Gasket

- Replace.

4 - Sealing ring

- Replace.

5 - Plug, 25 Nm

- Do not loosen.

6 - Plug, 25 Nm

7 - Sealing ring

- Replace.

8 - Oil filter element

- Check the installation position: top = upper.

9 - Sealing ring

- Replace.

10 - Draining plug, 25 Nm

11 - Gasket

- Replace.

12 - Oil radiator

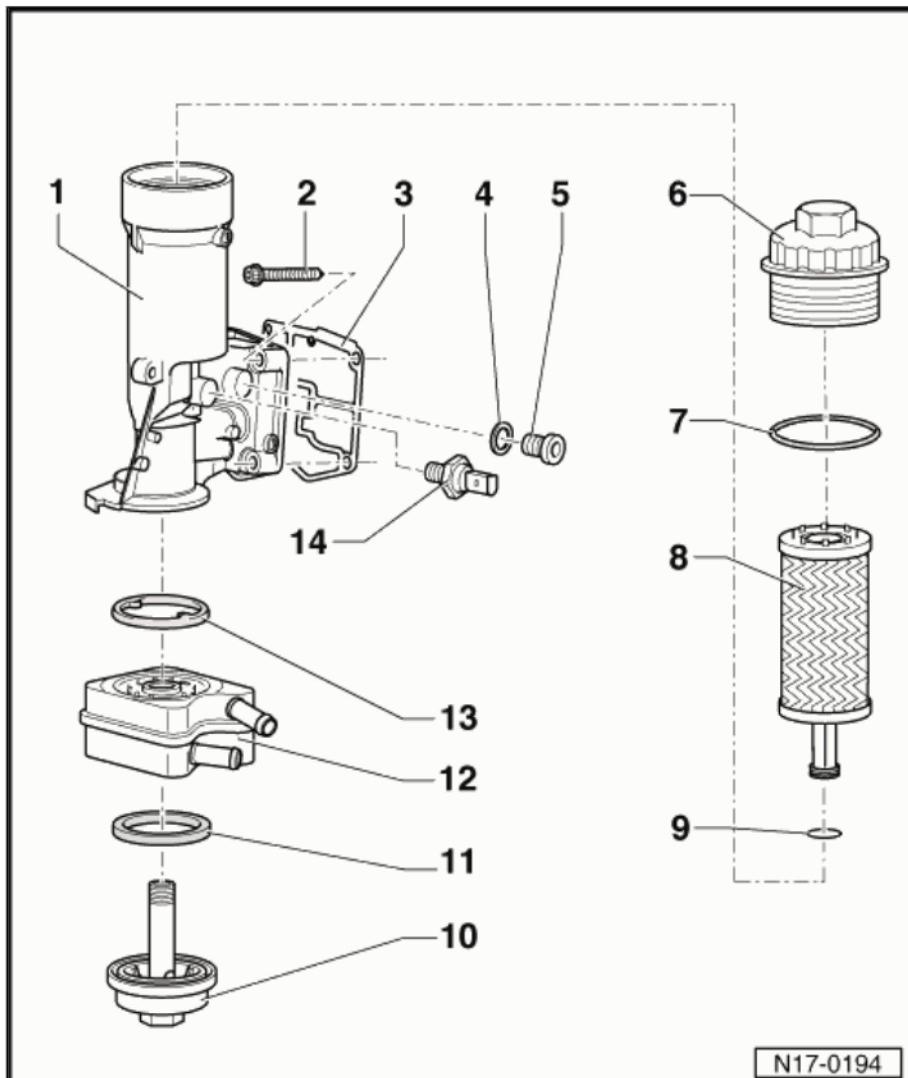
- Pay attention to the mobility with the adjacent components.
- Pay attention to the note [page 61](#).

13 - Sealing ring

- Replace.

14 - Oil pressure switch - F1- , 20 Nm

- 0,55 to 0,85 bar : brown.
- Tightening torque 17...23 Nm.
- In case of leakage, cut and replace the sealing ring.
- Check [page 68](#).
- Remove and install [page 65](#).





1.1 Crankcase - remove and install

Special tools and workshop equipment required

- ◆ Hinged wrench 10 mm -3185-
- ◆ Socket -T 10058-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Flat scraper
- ◆ Manual drill with plastic brush
- ◆ Silicone seal for engine. -D 176 404 A2 or A3-

3185	T10058
V.A.G 1331	
	W17-0027



1.1.1 Removal

- Remove the lower noise insulation from the engine.
- Drain the engine oil.



Note

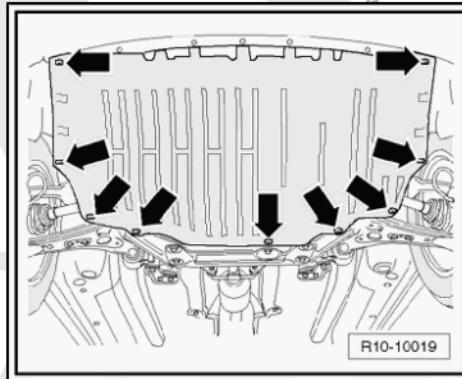
Comply with the disposal regulations!

- Loosen the housing.

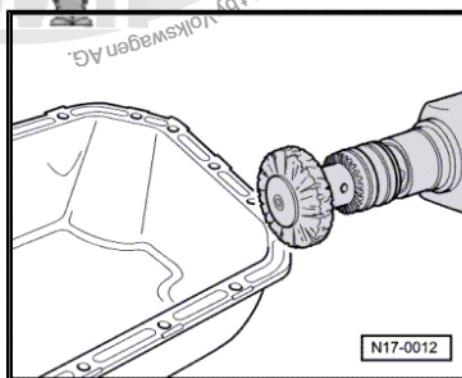


Note

Remove the flywheel-side screws with Swivel head wrench 10 mm -3185- and Socket -T 10058- .



- Remove the housing by slightly tapping it with rubber hammer.
- By using a spatula, eliminate residues of Engine silicone seal -D 176 404 A2 or A3- still remaining on the block.
- Eliminate residues of Engine silicone seal -D 176 404 A2 or A3- in crankcase by using a rotary brush, for example, a manual drill with synthetic brush (use goggles).
- Clean the sealing surfaces. They must be free from oil and grease.



1.1.2 Installation



Note

- ◆ *Observe the expiration date of the Engine silicone seal -D 176 404 A2 or A3- .*
- ◆ *Oil crankcase must be installed within five minutes after applying the Engine silicone seal -D 176 404 A2 or A3- .*

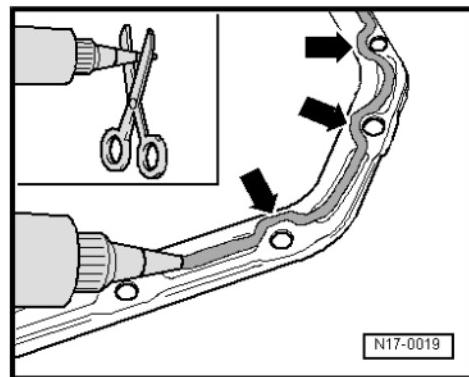


- Cut the tube injector on front marking (ejector Ø is approx. 3 mm).
- Apply the Engine silicone seal -D 176 404 A2 or A3-, as shown, onto clean crankcase seal surface. The sealing fillet must:
 - ◆ Be 2...3 mm thick.
 - ◆ Pass through the segment of the screw holes, inner side-arrows-.



Note

The sealing fillet must not be thicker to prevent that the excess Engine silicone seal -D 176 404 A2 or A3- penetrates into crankcase, and occasionally clogs the screen filter in the oil suction tube.



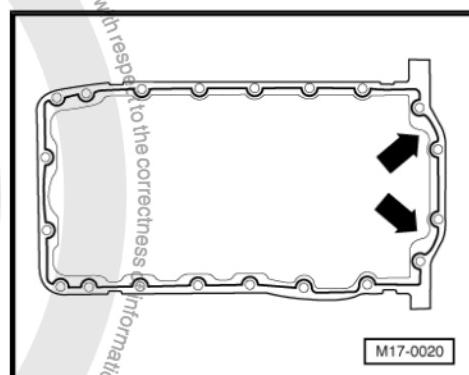
N17-0019

- As shown in the figure, the Engine silicone seal -D 176 404 A2 or A3- must be applied onto the clean seal surface of the housing. (The figure illustrates the Engine silicone seal -D 176 404 A2 or A3- fillet on the block)
- Install oil crankcase immediately and tighten all the screws to a slight torque.



Note

Install flywheel-side screws with the Socket-T 10058- and tighten with Swivel head wrench 10 mm -3185- .



M17-0020

- Tighten the housing screws in cross pattern with 15 Nm.
- Tighten crankcase/transmission screws to 45 Nm.



Note

After installing the crankcase, the seal must dry for approx. 30 minutes. Motor oil may be replenished only after this time period has elapsed.

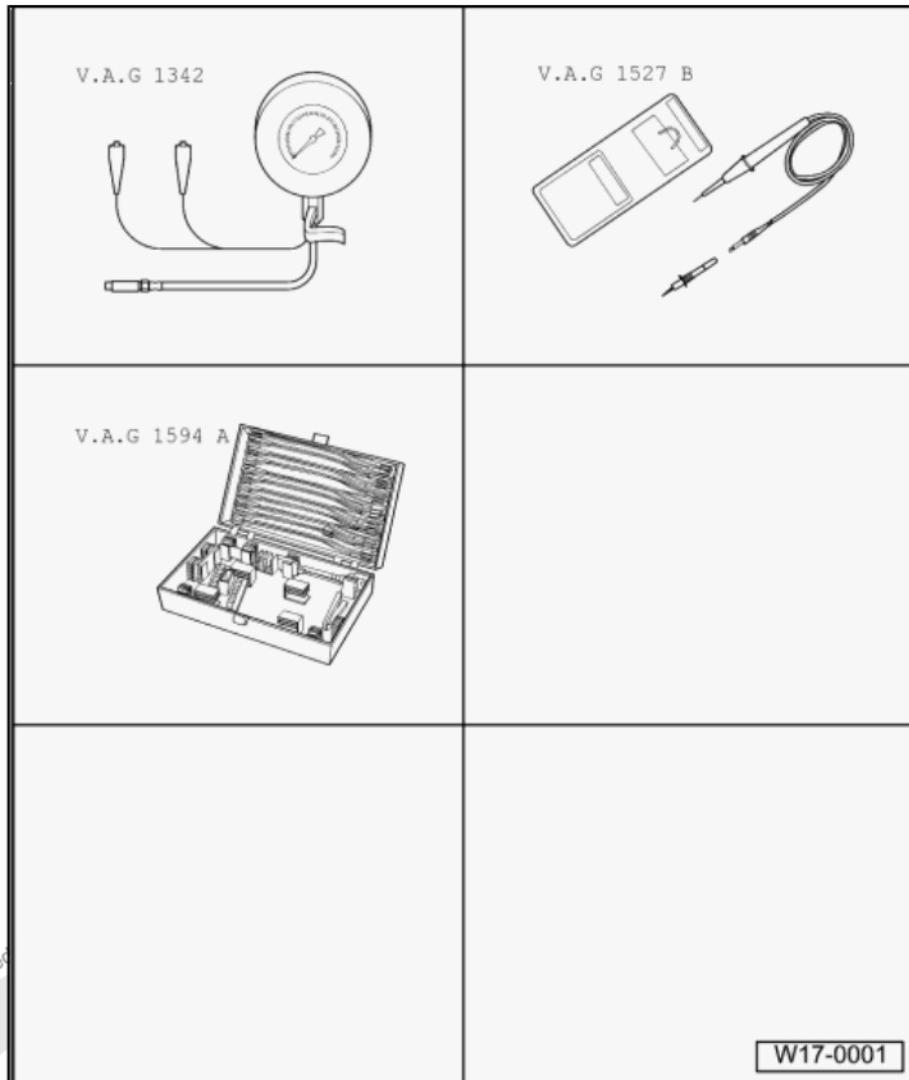
Install in reverse order from the removal.



1.2 Oil pressure and Oil pressure switch -F1- - check

Special tools and workshop equipment required

- ◆ Oil pressure gauge -VAG 1342-
- ◆ Test probe or VAG 1527B - EQ 7300-
- ◆ Auxiliary measuring cable set -VAG 1594C-



W17-0001

1.2.1 Functionality of the dynamic oil pressure warning indication

The Oil pressure switch -F1- opens when there is no pressure and closes when the switching pressure is reached.

The oil pressure warning is activated approx. 10 seconds after starting the ignition.

Oil pressure warning activation time approx. 3 seconds.

Oil pressure warning deactivation time approx. 5 seconds.

1.2.2 Check indicator light

After turning ignition on, with engine stopped, the oil pressure control light in the instrument case must turn on by approx. 3 seconds and turn off again. When the engine is running, the check is interrupted.



1.2.3 Warning criteria

The visual oil pressure warning (intermittent signal of the oil pressure control light) and the buzzer signal for audible warning occur under one of the conditions below.

- "Ignition ON", engine stopped, oil switch closed.
- Engine speed over 1500 rpm, oil switch open.



Note

- ◆ When the engine speed exceeds 5000 rpm, the control light remains ON, even with the switch. When the engine speed drops below 5000 rpm, the light turns off again.
- ◆ At an engine speed over 1500 rpm, if the oil pressure switch is open only during 0.3 ... 3.0 seconds, this is stored in the combined processor of the instrument case. If this situation repeats three times during the engine operation, the oil pressure alarm is immediately triggered and will not be reset at a speed below 1500 rpm. The oil pressure alarm reset will occur when the oil pressure switch remains closed more than 5 seconds over 1500 rpm, or when the ignition is turned off.

1.2.4 Checking conditions

- Oil level OK, check [page 63](#)
- The Oil pressure control light -K3- shall turn on during 3 seconds with ignition ON.
- Engine oil temperature at least 176 °F (the Radiator fan -V7- must have started once).





1.2.5 Checking sequence

- Remove the Oil pressure switch -F1- -A- and install it in the Oil pressure gauge -VAG 1342- .
- Install the Oil pressure meter -VAG 1342- in place of the Oil pressure switch -F1- on the oil filter support.
- Connect the brown cable of the Oil pressure gauge -VAG 1342- to earth (-).
- Connect Test probe -VAG 1527B- with Auxiliary measuring cable set -VAG 1594C- to positive terminal of Battery -A- (+) and to Oil pressure switch -F1- -B-.

The LED must not light up.

- If it the LED lights up, replace the Oil pressure switch -F1- .

If LED does not light up:

- Start the engine and keep it running at higher speed. At 0.55...0.85 bar, the LED must light up; otherwise, replace the Oil pressure switch -F1- .
- Continue increasing the speed. At 2000 rpm and an oil temperature of 176 °F, the oil pressure should be at 2.0 bar.

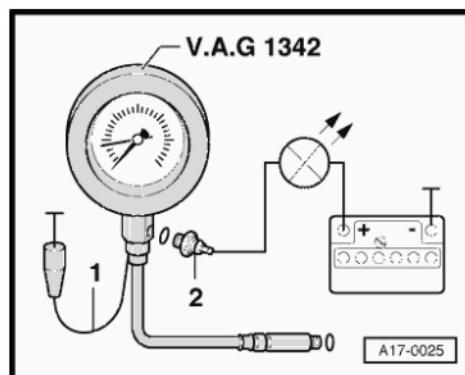
If the nominal values are not reached:

- Mechanical damages, for example, eliminate bearing damages.
- Replace the oil filter support by the overpressure valve or oil pump.

At higher speeds, oil pressure must not exceed 7.0 bar!

If the specification is exceeded:

- Check oil tubing.
- Occasionally, replace oil filter support by the overpressure valve.





19 – Cooling system

1 Cooling system components - remove and install



WARNING

In all installation works, especially in the engine compartment, due to lack of space, consider the following:

- ◆ All hoses (e.g. fuel, hydraulics, activated charcoal filter system, cooling system and cooling gas, brake fluid, vacuum) and electric cables must be restored to their original positions.
- ◆ Provide easy access to all the moving or hot parts.



Note

- ◆ The cooling system is under pressure when the engine is hot. Thus, it is necessary to reduce the pressure before doing repairs.
- ◆ Hose junctions are fastened by spring clamps. When doing repairs, use spring clamps only.
- ◆ To install spring clamps, we recommend using the Standard-type clamp pliers -VW 5162 - or Standard-type clamp pliers - VAS 5024A- or Clamp pliers -VAG 1921-.
- ◆ The cooling system hoses should be installed without tension and without coming into contact with other components (observe the marks on the cooling system connection on the hose).

Check the cooling system tightness with the Engine cooling system tester -VAG 1274- or Engine cooling system tester -VAG 1274B- and the Adapter for VAG 1274 -VAG 1274/8- and Adapter for VAG 1274 -VAG 1274/8- .

Cooling system components, body side [⇒ page 72](#) .

Cooling system components, engine side [⇒ page 73](#) .

Cooling system hose connection diagram [⇒ page 74](#) .

Drain and replenish the cooling system [⇒ page 75](#) .

Instructions for preparing coolant [⇒ page 75](#) .



1.1 Cooling system components in the body

1 - Radiator

- Remove and install
[⇒ page 81](#).
- After replacement, exchange all coolant.

2 - Sealing ring

- Replace.

3 - Upper cooling system hose

- Fastened to the radiator through a clip.
- Make sure it is well fastened.
- Cooling system hose connection diagram
[⇒ page 74](#).

4 - Cover

Check for cooling system leaks using the Engine cooling system tester - VAG 1274- or Engine cooling system tester - VAG 1274B- and the Adapter for VAG 1274 - VAG 1274/9- .

- Test pressure 1.4 ... 1.6 bar.

5 - 5 Nm

6 - Coolant reservoir

Check for cooling system leaks using the Engine cooling system tester - VAG 1274- or Engine cooling system tester - VAG 1274B- and the Adapter for VAG 1274 - VAG 1274/8- .

7 - Support

- For the Radiator fan -V7- .
- Observe installation position.
- Observe various models.
- For radiator fan connector -V7- .

8 - 5 Nm

9 - Support

- For Radiator fan -V7- .

10 - 10 Nm

11 - Radiator fan -V7-

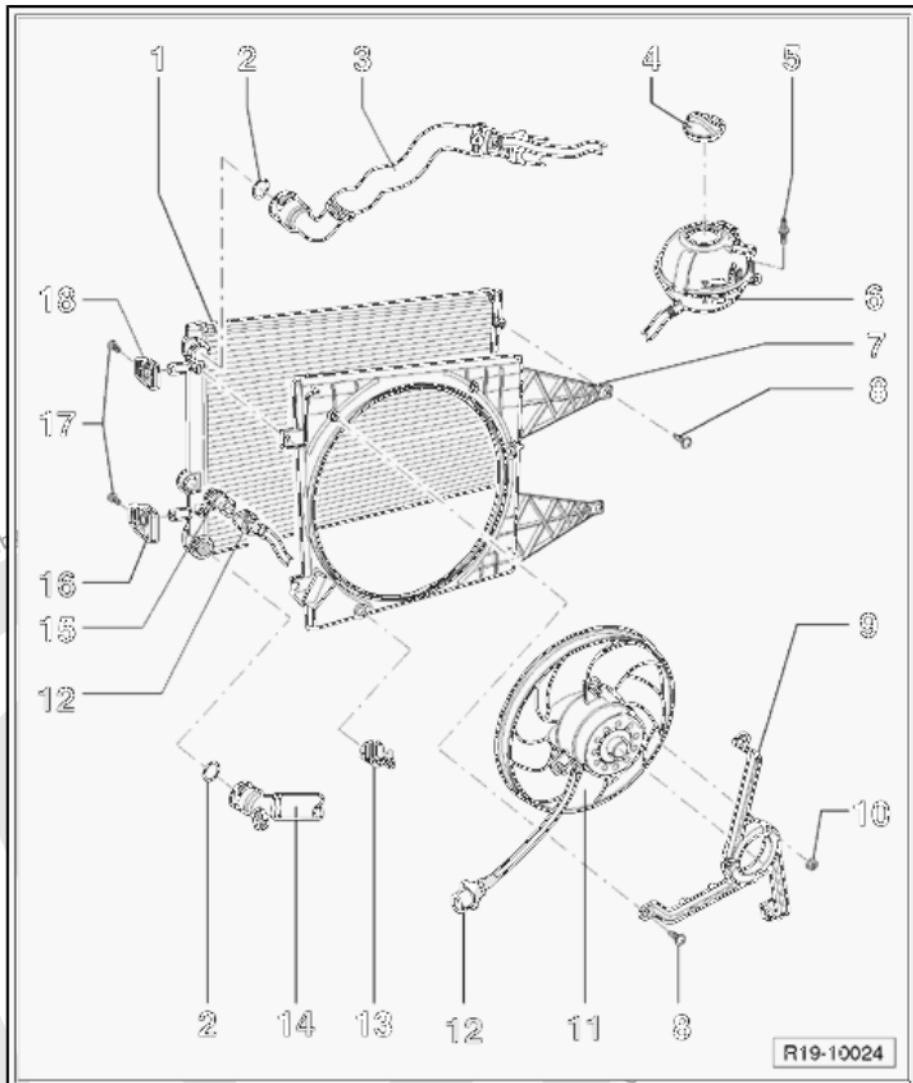
12 - Connector

13 - Support

- For radiator fan connector -V7- .

14 - Lower cooling system hose

- Fastened to the radiator with retaining clip.
- Make sure it is well fastened.





- Cooling system hose connection diagram [⇒ page 74](#).
- 15 - Radiator fan thermal switch -F18- , 35 Nm
 - For Radiator fan -V7- .
 - Starting temperatures: Stage 1 ON: 92...97° C OFF: 84° C. Stage 2 ON: 99...105° C OFF: 91° C.
- 16 - Radiator lower bearing
- 17 - 5 Nm
- 18 - Radiator upper support
 - White.

1.2 Cooling system components in the engine

1 - Cooling system upper tube

- Fastened to the intake manifold.

2 - 10 Nm

3 - Coupling nozzle

- To heat exchanger.

4 - Coupling nozzle

- In the cylinder head.

5 - Distribution part

6 - To upper side of radiator.

- Cooling system hose connection diagram [⇒ page 74](#).

7 - 15 Nm

8 - Coolant temperature sensor -G62-

- For Engine control unit - J623- .
- Depressurise system before the removal.

9 - Clip

- Ensure it is fastened firmly.

10 - Sealing ring

- Replace.

11 - Sealing ring

- Replace.

- Ensure it is fastened firmly.

12 - Cooling system rigid pipe

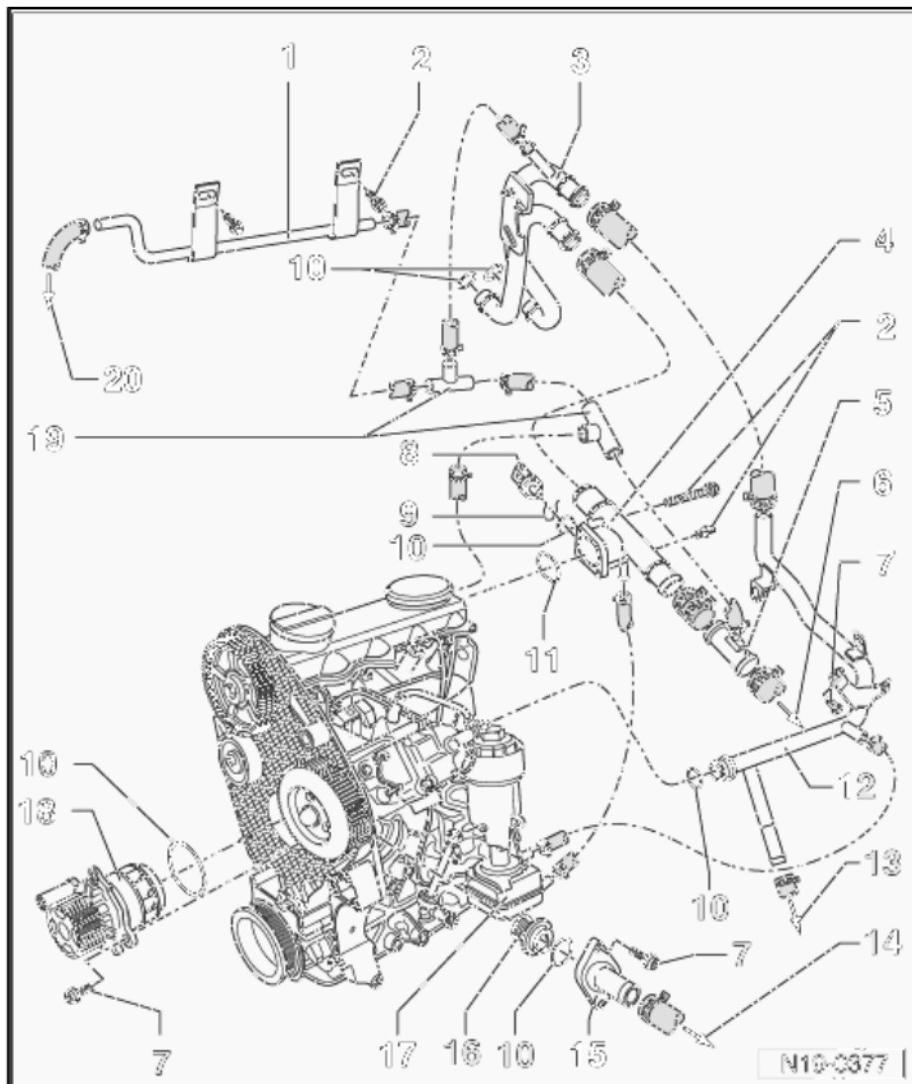
- Cooling system hose connection diagram [⇒ page 74](#).

13 - For coolant reservoir

- Cooling system hose connection diagram [⇒ page 74](#).

14 - To lower part of radiator

- Cooling system hose connection diagram [⇒ page 74](#).





15 - Thermostat valve flange

16 - Thermostat valve

- Check: heat the valve in double boiler.
- Opening start approx. 188.5 °F.
- Minimum opening travel 7 mm at 210...221 °F.

17 - Oil radiator

18 - Water pump

- Check mobility.
- In case of damages and leaks, replace completely.
- Remove and install [⇒ page 79](#).

19 - Distribution part

1.3 Cooling hose connection diagram.

1 - Radiator

2 - Oil radiator

3 - Thermostat valve for the cooling system

4 - Water pump

5 - Cylinder head/crankcase

6 - Coolant reservoir

7 - Cooling system upper tubing

8 - Coupling nozzle

- In the cylinder head.

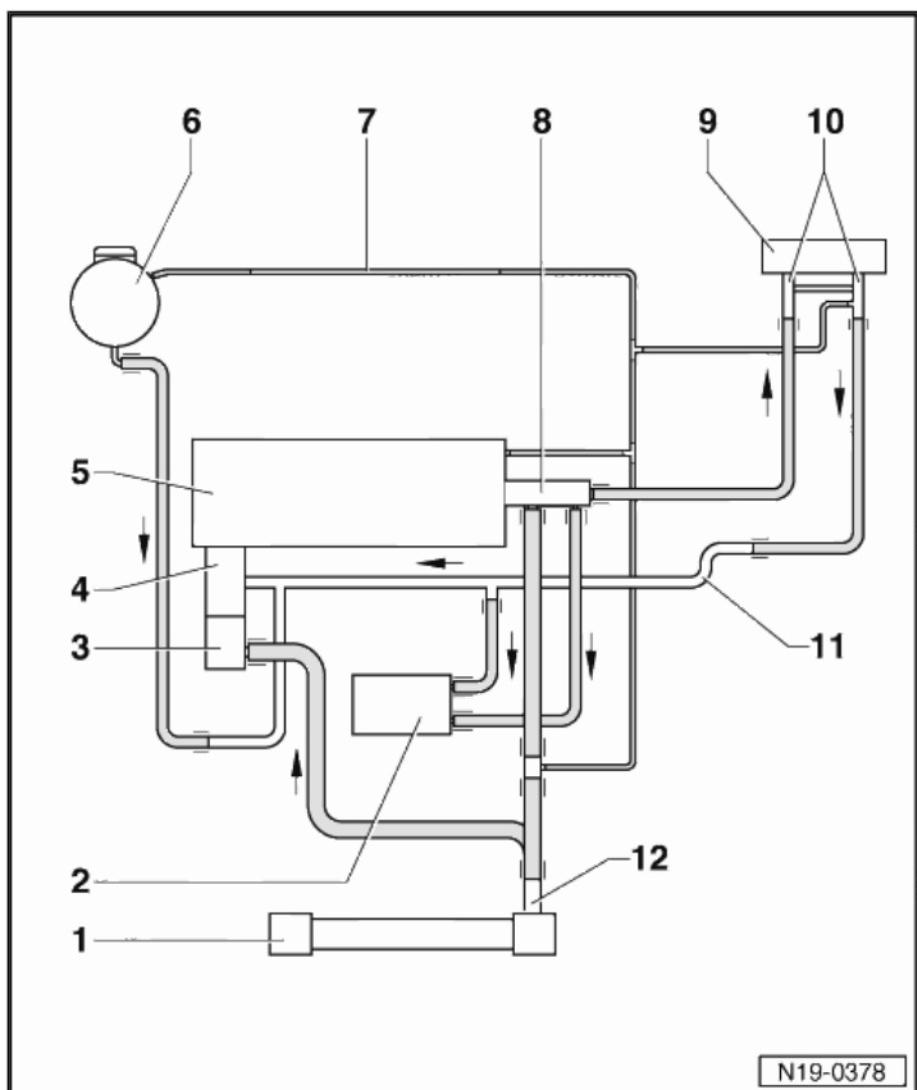
9 - Heat exchanger for heating

10 - Coupling nozzle

- To heat exchanger.

11 - Cooling system pipe

12 - Quick coupling



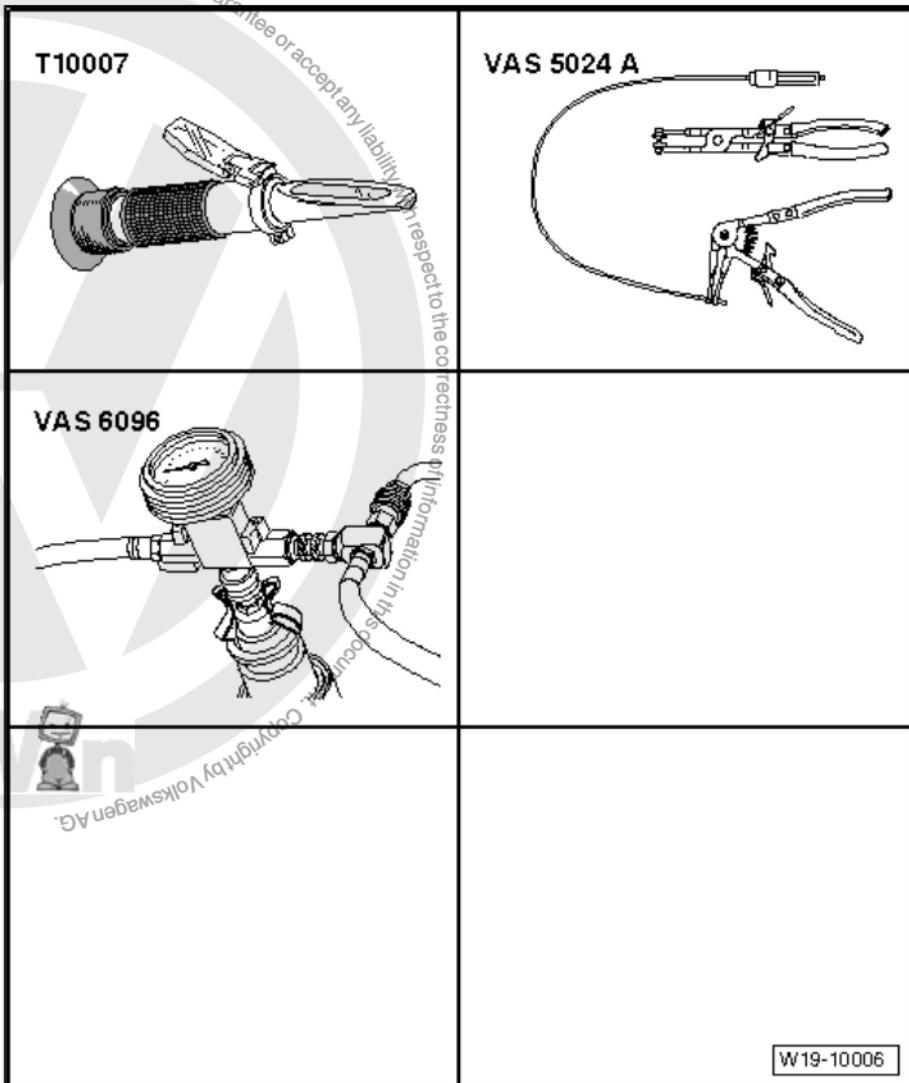
N19-0378



1.4 Cooling system - drain and fill

Special tools and workshop equipment required

- ◆ Refractometer for analysing the cooling system liquid -EQ 7093- or Refractometer for analysing the cooling system liquid -T10007-
- ◆ Standart-type clamp pliers -VAS 5024A- or Standart-type clamp pliers -VW 5162-
- ◆ Oil trap -VAG 1306-
- ◆ Cooling system supply unit -VAS 6096-



1.4.1 Drain

- Remove coolant reservoir lid.

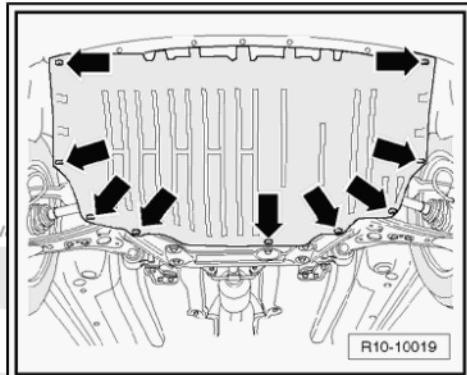


WARNING

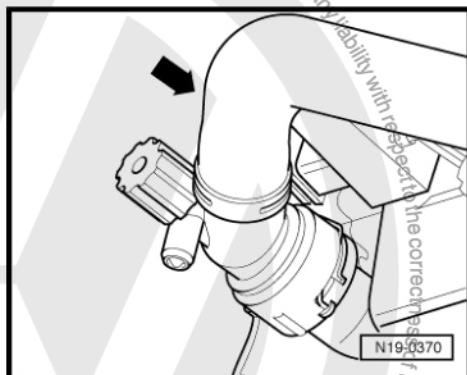
Hot vapours may escape when the coolant reservoir is opened; cover it with a cloth and open carefully.



- Remove the lower noise insulation from the engine.
- Drain the cooling system [⇒ page 75](#).
- Remove the hoses from the engine with Standart-Type clamp pliers -VW 5162 (VWB) - ou - VAS 5024A- .



- Also remove the lower hose in the radiator -arrow- .

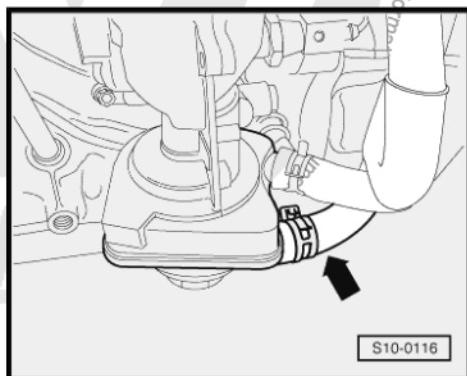


- To drain the engine cooling system, remove also the oil radiator cooling hose -arrow-.



Note

Observe the disposal regulations for coolants!





1.4.2 Replenish



Note

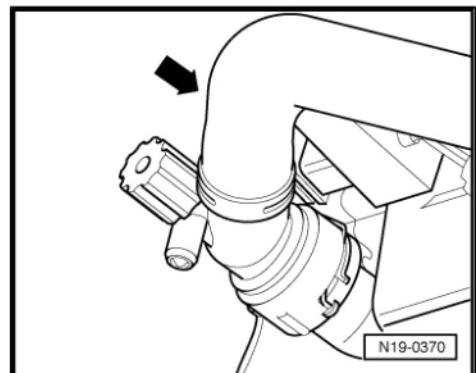
- ◆ Use only G 12 as coolant additive, according to TL -VW 774 F-. Feature: violet color
- ◆ G 12 violet (as per TL -VW 774 F-) may be mixed with the G 12 red additive used to this date!
- ◆ G 12 and coolant additives with the note "compliant with TL -VW 774- F" prevent corrosion damages and calcium sedimentation, in addition to increase the boiling temperature. Due to this reason, the cooling system must be replenished throughout the year with antifreeze and anti-corrosive additives.
- ◆ Especially in countries with tropical climate, the high boiling point of the coolant with the engine running at higher speed regimes contributes to work safety.
- ◆ Antifreeze must be active down to approx. -13 °F (in Arctic climate countries up to approximately -31 °F).
- ◆ The coolant concentration in hot season or countries with tropical climate must not be reduced by water addition. The minimum additive proportion must be 40%.
- ◆ If due to climatic reasons, it is necessary to use a more efficient antifreeze, it is possible to increase G 12 addition, but only to 60 % (Antifreeze up to approx. -40 °F); otherwise, the antifreeze is reduced again and the cooling action is worsened.
- ◆ For determining the current antifreeze effect, it is recommended the use of Refractometer for analysing the cooling system liquid -EQ 7093- or Refractometer for analyzing the cooling system liquid - T10007- .
- ◆ In case of changing the radiator, heat exchanger, cylinder head or cylinder head gasket, do not reuse the old coolant when replenishing.

Recommended mixture proportions:

Antifreeze effect up to	Antifreeze pro- portion	G 12 ⁴⁾	Water ⁴⁾
-13 °F	40 %	2.0 l	3.0 l
-31 °F	50 %	2.5 l	2.5 l

4) The coolant volume may vary according to the vehicle's accessories.

- Install lower hose in the radiator -arrow- .



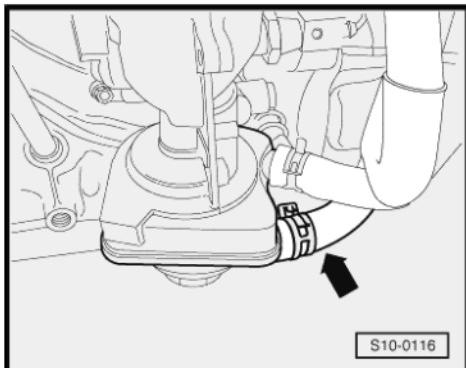


- Install cooling hose in the oil radiator -arrow- .

With Cooling system supply unit -VAS 6096-

- Install the Adapter for VAG 1274 -VAG 1274/8- in the coolant reservoir suitable for this vehicle.
- Fill the cooling system with the Cooling system supply unit - VAS 6096- ⇒ Operation instructions for the Cooling system supply unit -VAS 6096- .

Without the Cooling system supply unit -VAS 6096-



- Fill with coolant up to the max. mark on the coolant reservoir.

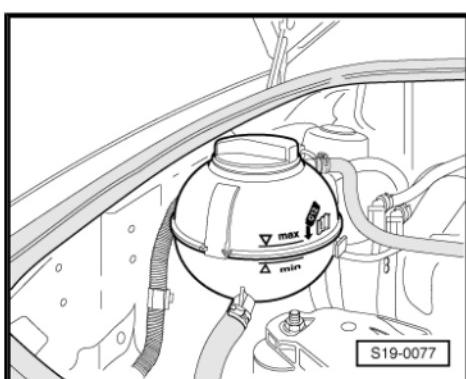
With or without Cooling system supply unit -VAS 6096-

- Start engine and maintain a speed of about 2,000 rpm for approx. 3 minutes.
- Run the engine until the Radiator fan -V7- starts.



WARNING

Hot vapour may escape when the coolant reservoir is opened; cover it with a cloth and open carefully.



- Check coolant level, and if necessary, correct: With hot engine, the coolant level must reach upper mark of graduated field. With cold engine, coolant level must be on the centre of graduated field.

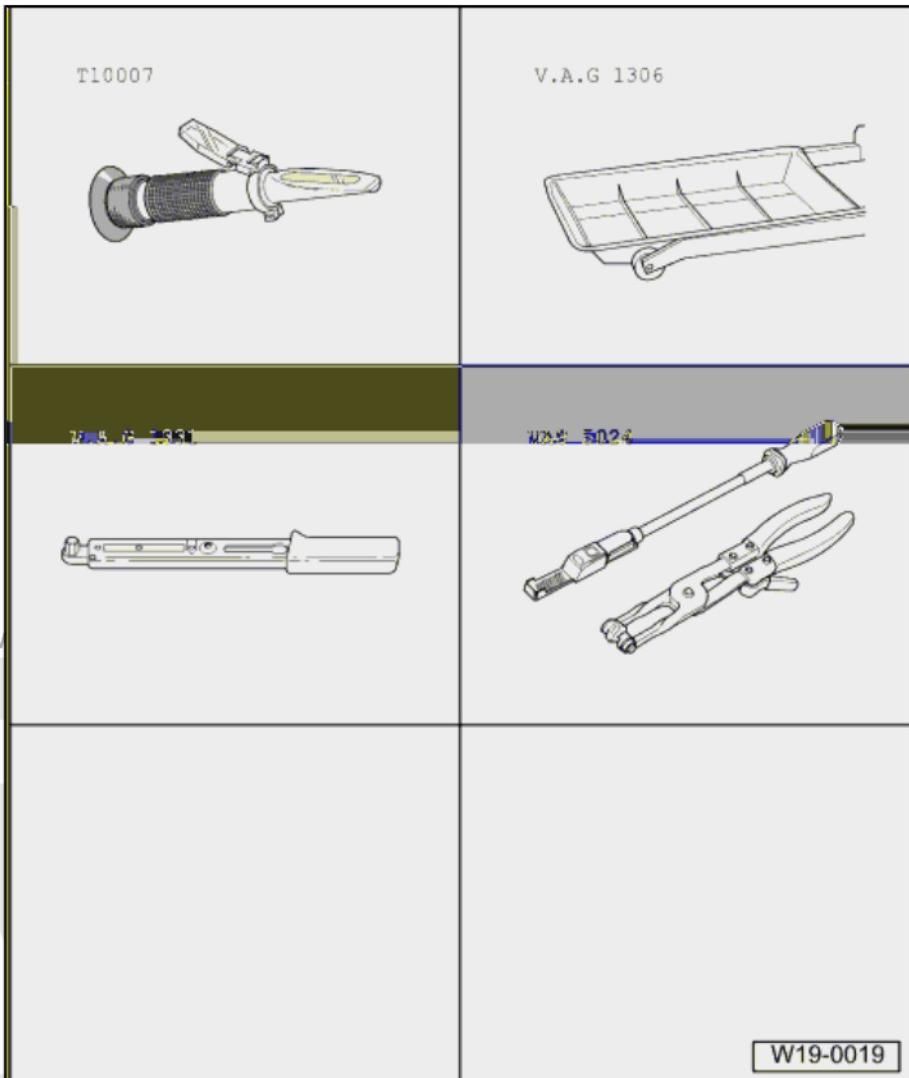




1.5 Water pump - remove and install

Special tools and workshop equipment required

- ◆ Refractometer for analysing the cooling system liquid -EQ 7093- or Refractometer for analysing the cooling system liquid - T 10007-
- ◆ Oil trap -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Standart-type clamp pliers - VW 5162- or Standart-type clamp pliers -VAS 5024A- or Clamp pliers -VAG 1921-



1.5.1 Removal

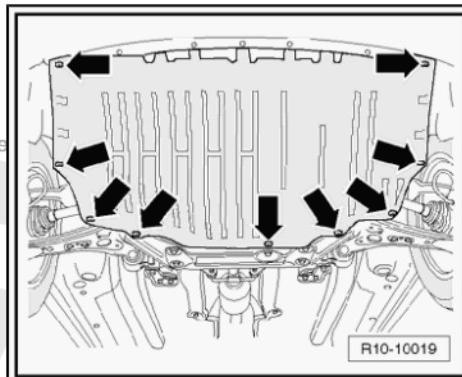


Note

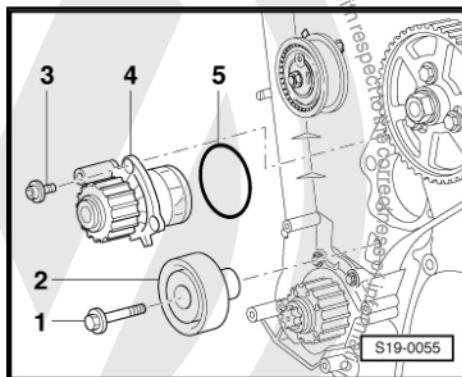
- ◆ Gaskets and seal rings must always be changed.
- ◆ The lower cover of the mechanical distribution can remain installed.
- ◆ The toothed belt remains installed on the crankshaft gear.
- ◆ To protect toothed belt against coolant, cover it with a cloth before removing the water pump.



- Remove the lower noise insulation from the engine.
- Drain the cooling system [⇒ page 75](#).
- Remove the Poly-V belt [⇒ page 15](#).
- Remove mechanical distribution upper and intermediate cover [⇒ page 11](#) and [⇒ page 36](#).
- Remove the camshaft gear toothed belt [⇒ page 36](#).



- Remove the fastening screw -1- from pulley -2- and remove pulley.
- Remove the water pump -4-



1.5.2 Installation

Install by inverting the removal sequence, paying attention to the following:

- Moisten the sealing ring -5- with coolant.
- Install the crankcase water pump. Tightening torque: 15 Nm.
- Replace the fastening screw -1- on pulley -2- and install pulley. Tightening torque: 40 Nm + 90°.

Installing the toothed belt and adjusting distribution times
[⇒ page 36](#).

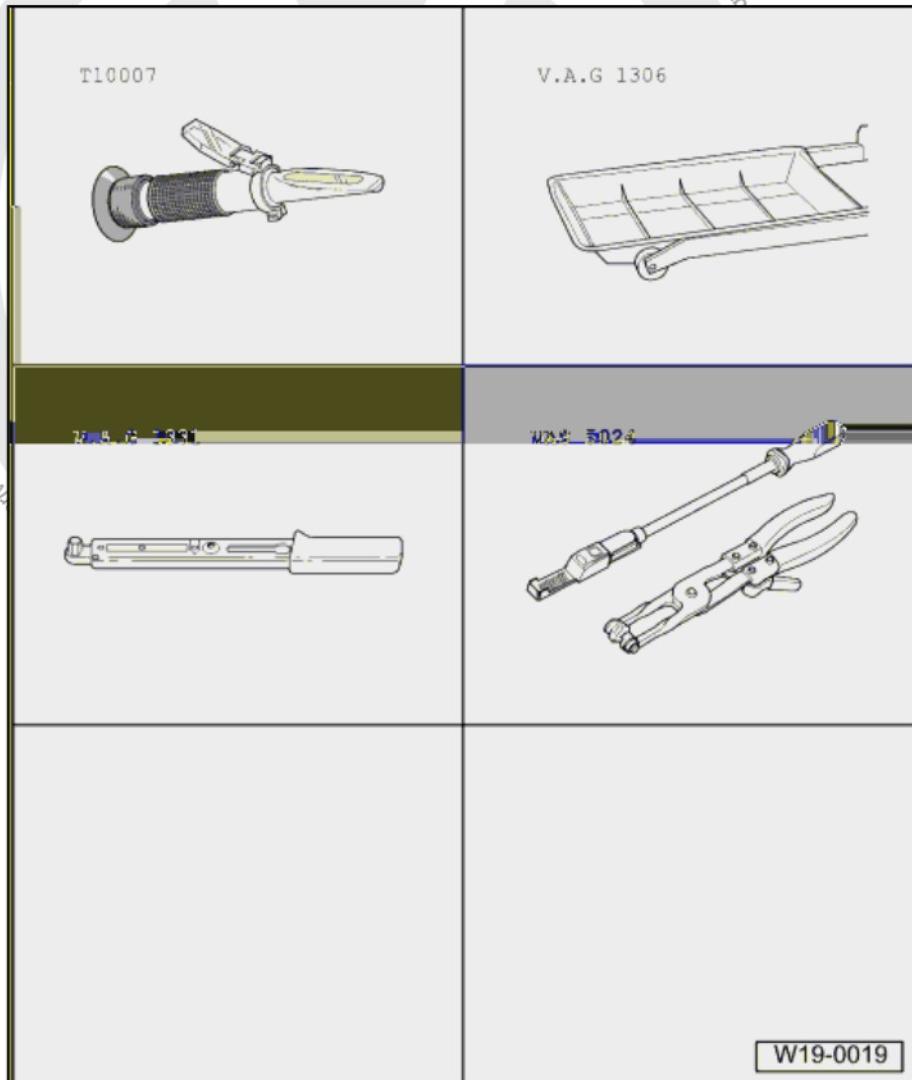
- Install Poly-V belt [⇒ page 15](#).
- Fill cooling system [⇒ page 75](#).



1.6 Radiator - remove and install

Special tools and workshop equipment required

- ◆ Refractometer for analysing the cooling system liquid -EQ 7093- or Refractometer for analysing the cooling system liquid -T 10007-
- ◆ Oil trap -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Standart-type clamp pliers - VW 5162- or Standart-type clamp pliers -VAS 5024A, or Clamp pliers -VAG 1921-

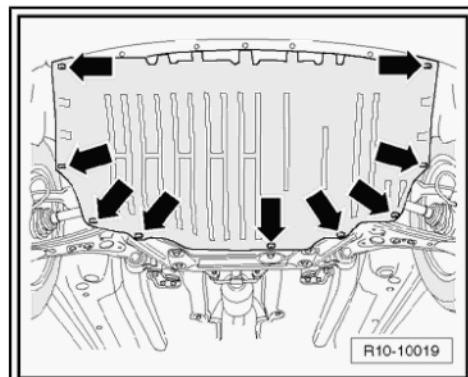


1.6.1 Removal

- Remove the lower noise insulation from the engine.
- Remove bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 ; Bumpers .
- Remove front panel ⇒ General body repairs, exterior; Rep. Gr. 50 ; Body - Front part .
- Drain the cooling system ⇒ [page 75](#) .
- Loosen quick couplings from the radiator cooling system hoses.
- Disengage the Radiator fan -V7- connector from radiator.
- Loosen the radiator fastening screws and remove the radiator with Radiator fan -V7- .

Vehicles with air conditioning

- Observe additional indications and installation works ⇒ [page 82](#) .





1.6.2 Installation

Installation is carried out by inverting the removal sequence, observing the following:

- Fill cooling system [⇒ page 75](#).
- Install front panel ⇒ Body - External assembly works; Rep. Gr. 50 ; Body - Front part .
- Install bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 ; Bumpers .

1.6.3 Additional notes and installation works in vehicles with air conditioning



WARNING

It is forbidden to open the air conditioning gas circuit.



Note

To prevent faults in the cooling gas hoses and condenser, make sure the hoses are not stretched, bent or crushed.

- Loosen cooling gas hose retaining clamp(s).
- Loosen radiator condenser and support it.



1.7 Thermostat valve - remove and install

Special tools and workshop equipment required

- ◆ Oil trap -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Standart-type clamp pliers - VW 5162- or Standart-type clamp pliers -VAS 5024A- or Clamp pliers -VAG 1921-
- ◆ Refractometer for analysing the cooling system liquid -EQ 7093- or Refractometer for analysing the cooling system liquid - T 10007-

 <p>V.A.G 1306</p>	 <p>V.A.G 1331</p>
 <p>V.A.G 1921</p>	
	W19-0001

1.7.1 Removal



Note

Gaskets and seal rings must always be changed.

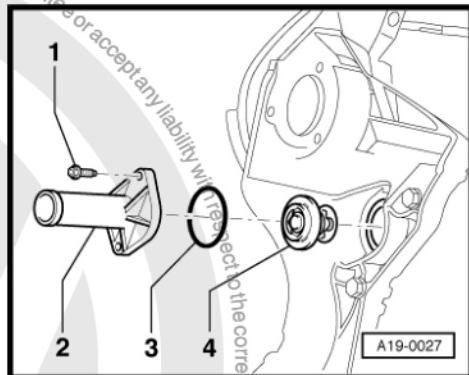
- Drain the cooling system [page 75](#).

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Use of information in this document.



- Remove the hose from the fitting flange -2-.
- Remove the fastening screws -1- from the fitting flange -2- and remove the fitting flange -2- with thermostat valve -4-.
- Turn the thermostat valve -4- $1/4$ (90°) anti-clockwise to remove fitting flange -2- .



1.7.2 Installation

Install by inverting the removal sequence, paying attention to the following:

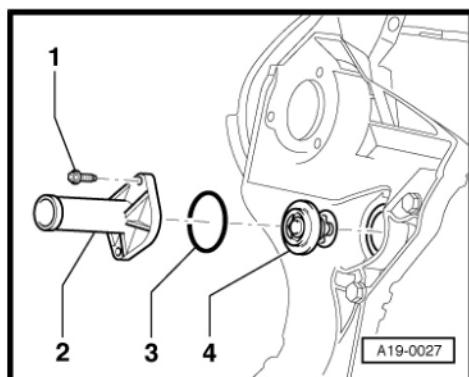
- Moisten the new sealing ring -3- with coolant.
- Install the thermostat valve -4- on the fitting flange -2- by turning it $1/4$ 90° clockwise.



Note

The thermostat valve arcs must be in a position approximately vertical.

- Mount the fitting flange -2- with thermostat valve -4- on the crankcase.
- Tighten fastening screws -1-. Tightening torque: 15 Nm.
- Fill cooling system [⇒ page 75](#) .





20 – Supply system - Fuel tank, fuel pump

1 Fuel supply system components - remove and install



Note

- ◆ *The hose fittings are fastened through spring and tightening clamps.*
- ◆ *Always replace fastening clamps with spring-type clamps.*
- ◆ *To install spring clamps, we recommend using the Standard-type clamp pliers -VW 5162 - or Standard-type clamp pliers - VAS 5024A- or Clamp pliers -VAG 1921- .*

Follow safety measures [⇒ page 89](#).

Follow cleaning rules [⇒ page 89](#).

Remove and install fuel tank [⇒ page 86](#).

Repair fuel filter [⇒ page 88](#).

Engine power electronic adjustment (electronic accelerator):
check [⇒ page 94](#).



1.1 Fuel tank with accessories - remove and install

1 - Clip

2 - Fuel tank lid

3 - Ring

4 - Fastening screw

5 - Fuel tank nozzle compartment lid

With rubber bellows.

Remove and install ⇒
Rep. Gr. 55

6 - Fuel supply tube

7 - Vent valve

For the filter to the environment.

8 - Gravity valve

From fuel tank to vent valve.

Check valve passage.
Vertical valve: open.
Valve with 45° inclination closed.

9 - Vent filter

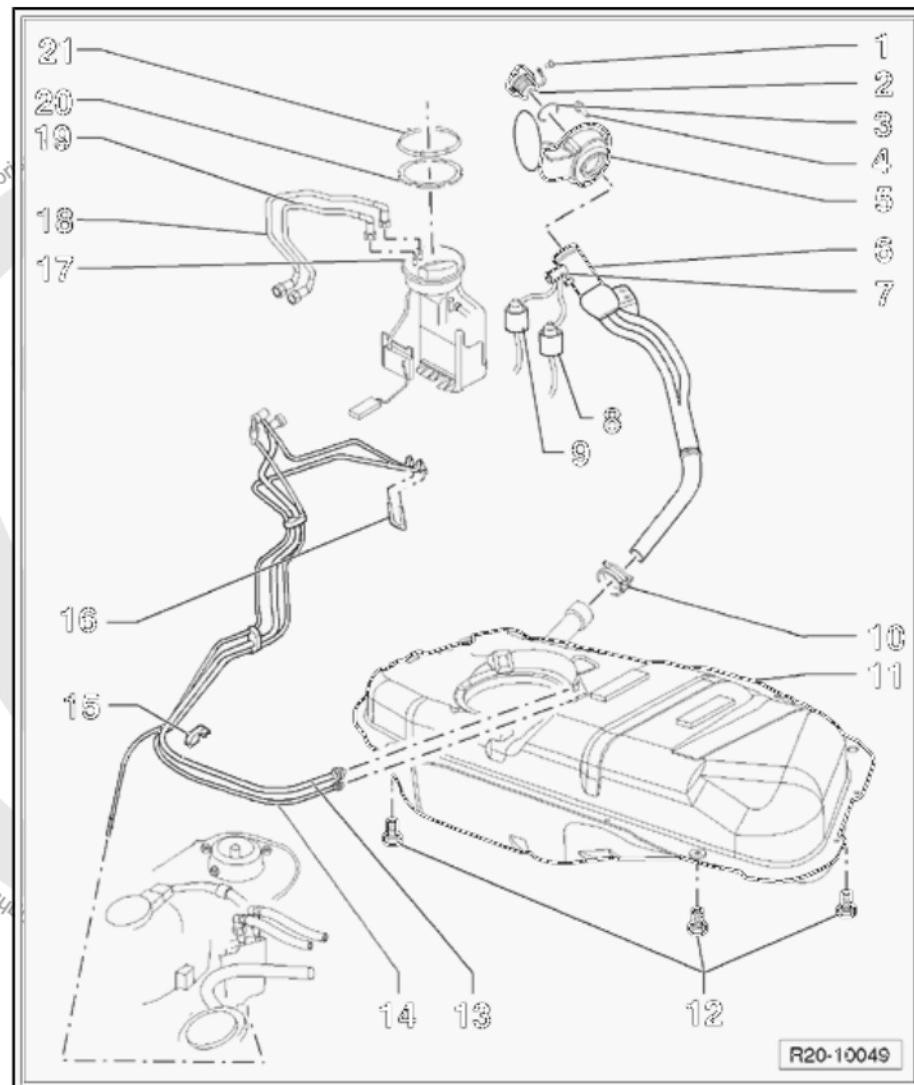
From the vent valve to environment.

10 - Elastic tie

11 - Fuel tank

Support with the Transmission jack or engine + transmission set or EQ 7081 -VAG 1383A- .

Remove and install
⇒ [page 90](#).



12 - 26 ± 3 Nm

13 - Vent hose

Fastened to the upper part of the fuel tank.
 Ensure it is fastened firmly.

14 - Vent hose

Fastened to the upper part of the fuel tank.
 Ensure it is fastened firmly.

15 - Clip

16 - Lock

17 - Fuel level indicator sensor -G-

Observe the flange installation position in the fuel tank ⇒ [page 87](#)
 Remove and install the fuel tank ⇒ [page 91](#).
 Remove and install fuel level meter ⇒ [page 93](#).

18 - Pipe line

To the fuel filter.
 Fastened on the fuel tank.



- Ensure it is fastened firmly.
- Black.

19 - Return hose

- For the fuel filter.
- Blue or blue mark.
- Fastened on the fuel tank.
- Ensure it is fastened firmly.

20 Thrust ring

21 Circlip

- Remove and install with the Wrench -VW 5321/9- or Wrench -T10334-

Installation position of the Fuel level indicator sensor - G- .

The -arrow- stamped on the Fuel level indicator sensor -G- must match with the spot marked on the fuel tank -arrow-.

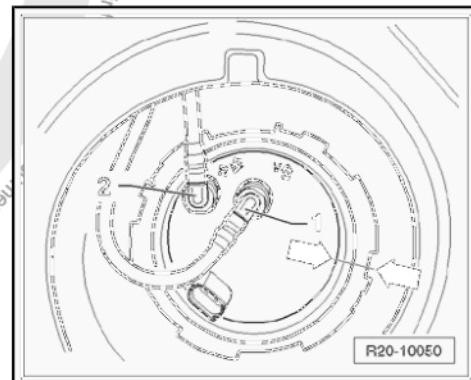
Supply tubing black -1- or black marked on the fitting with -V- marking.

Return tubing -2- blue or blue marked marked on the fitting with -R- marking.



Note

After installing the Fuel level indicator sensor -G- , check whether supply and return tubes and vent tubes are still fastened on fuel tank.



Check vent valve

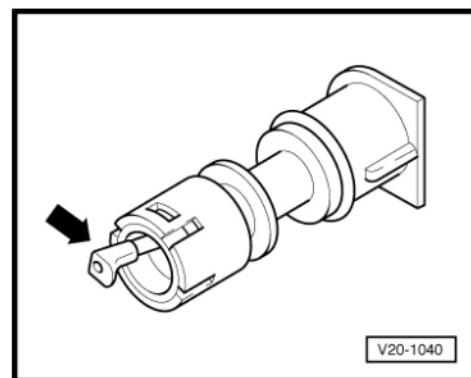
Lever in rest position: closed.

Lever pushed towards -arrow-: open.



Note

Before vent valve installation, remove fuel tank lid.





1.2 Fuel filter - repair

1 - Return hose

- From injector pump.
- Blue or blue mark.
- Ensure it is fastened firmly.

2 - Feeding hose

- To injector pump .
- White or white mark.
- Ensure it is fastened firmly.

3 - Clip

- Ensure it is fastened firmly.

4 - Regulator valve

- Installation position:
-Arrow- direction to fuel tank.
- When changing the filter, remove the clamp and regulator valve with the fuel hoses connected.
- When below + 15° C:
Passage to filter open.
- When over + 31° C:
Passage to filter closed.

5 - Return hose

- To the fuel filter.
- Blue or blue mark.

6 - Pipe line

- From tank.
- White or white mark.

7 - Fuel filter:

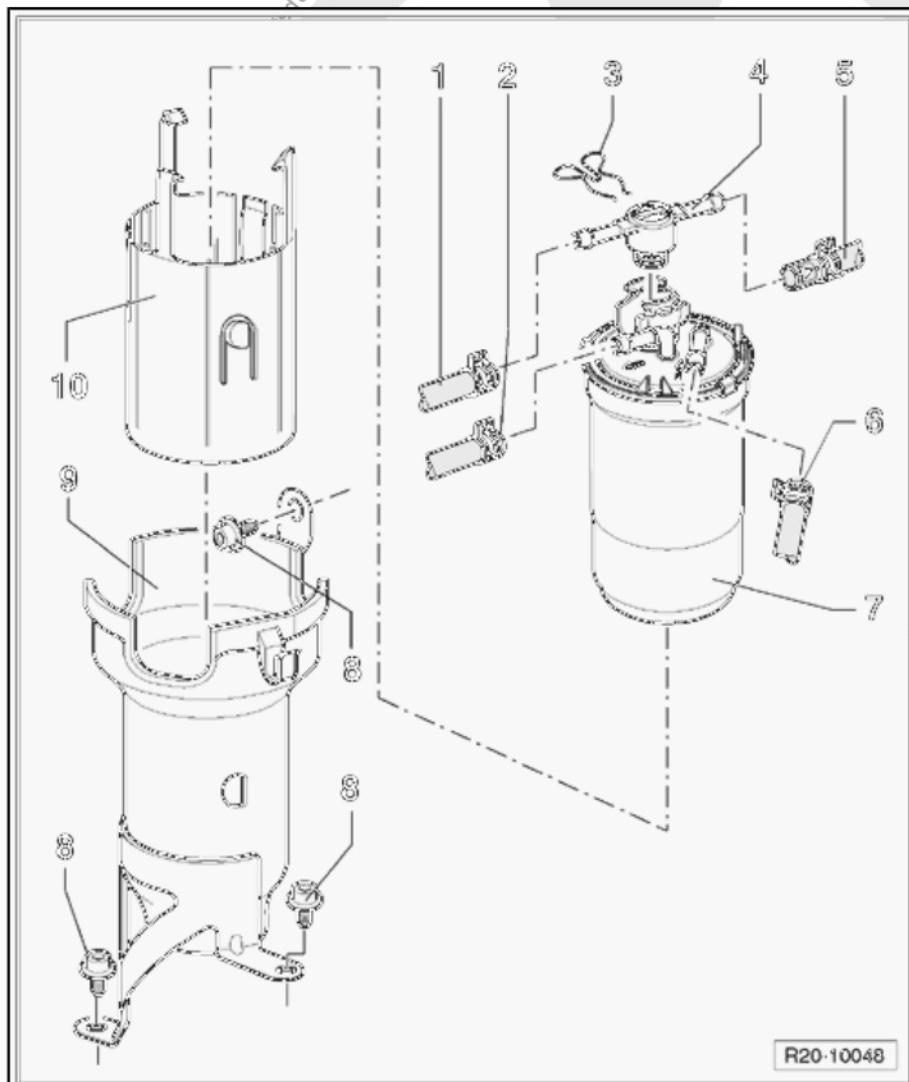
- Remove and install [page 89](#)
- Before installing, replenish with Diesel.
- The flow direction is marked with -arrows-.
- Do not invert connections
- Replace when damaged.

8 -

9 - 25 Nm

10 - Fuel filter support

11 - Locking fitting/device





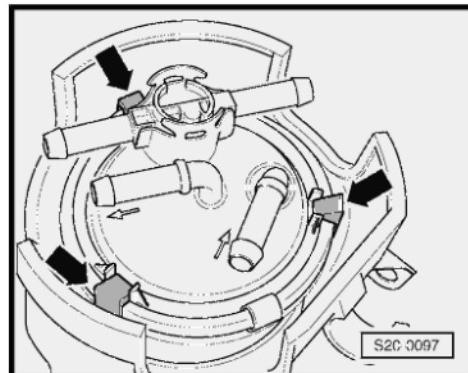
Remove and install fuel filter

Move the locks -arrows- outwards and remove fuel filter.



Note

The fuel filter can only be placed in one position.



1.3 Safety measures when working in the supply system



WARNING

During assembly works, especially within the engine compartment, due to the lack of space, bear in mind the following:

- ◆ All hoses (e.g. fuel, hydraulics, activated charcoal filter system, cooling system and cooling gas, brake fluid, vacuum) and electric cables must be restored to their original positions.
- ◆ Provide easy access to all the moving or hot parts.



WARNING

- ◆ Both the fuel and the fuel tubes may become very hot (risk of burns)!
- ◆ In addition, the fuel system is under pressure! Before opening the system, place a cloth on the fitting and relieve the pressure by carefully loosening it!
- ◆ Always use goggles and gloves in all the installation works in the fuel system!

When removing and installing the Fuel level indicator sensor -G- in reservoirs full or partially full, pay attention to the following items:

- ◆ Before starting works, it is necessary to have, near the installation area of fuel tank, the suction hose of a gas exhausting equipment in operation, to absorb gases released by the fuel. If extracting equipment is unavailable, use a radial fan (the engine must be out of air flow) with air movement rate higher than 15 m³/ hour.
- ◆ Avoid skin contact with fuel! Use fuel resistant gloves!

1.4 Cleaning rules

For jobs on the fuel / injection system, strictly observe the following "6 cleaning" rules:

- ◆ Clean thoroughly the connections and surrounding areas before disconnecting them.
- ◆ The parts removed must be placed on a clean surface and covered. Do not use cloths that fray!



- ◆ If repair works are not to be carried out immediately, opened components must be covered up or carefully preserved.
- ◆ Install clean components only. Remove spare parts from packaging only before installing them. Do not install components that have been kept out of packaging (i.e. inside the tool box, etc.).
- ◆ With system open: If possible, avoid using compressed air. If possible, do not move the vehicle.
- ◆ Take care to prevent diesel fuel from contacting the cooling hoses. If this occurs, clean the hoses immediately. Damaged hoses must be changed.

1.5 Fuel tank - remove and install

Special tools and workshop equipment required

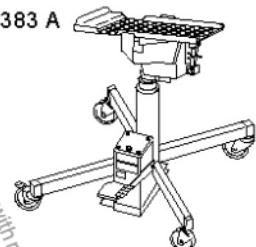
- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-

V.A.G 1331



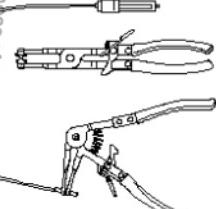
W00-0427

V.A.G 1383 A



W00-0120

VAS 5024 A



W00-1179

- ◆ VAS 5024A or Standart-type clamp pliers -VW 5162- or Pliers -VAG 1921-

1.5.1 Removal

- Before starting works, check safety measures [⇒ page 89](#).



Note

During the work sequence, the Battery -A- earth strap will have to be disconnected. Therefore, check first whether a code radio is installed. If so, first obtain the anti-theft system code.

- With the ignition switched off, disconnect the Battery -A- earth strap.
- Fold rear seat forwards.
- Remove the access cover of the Fuel level indicator sensor - G- and disengage the 2-pole connector.
- Drain fuel tank.
- Remove reservoir lid.
- Remove fuel hoses from the fuel tank.
- Exhaust system must be lowered a bit, and fastened to the body with a metallic wire.
- Remove heat deflector between the exhaust tube and the fuel tank.
- Remove fastening clips from the supply tube by using the Standart-type clamp pliers or VAS 5024A -VW 5162- or Pliers -VAG1921- .
- Support fuel tank with Transmission jack or engine + transmission set -EQ 7081- or Transmission jack or engine + transmission set -VAG 1383A- .
- Remove fuel tank fastening screws.
- Lower fuel tank.



Note

To disconnect hose fittings, press the connection buttons.

1.5.2 Installation

Install in reverse order from the removal. Please note the following:

- ◆ Install fuel vent hoses in order not to bend them.
- ◆ Make sure the fuel hoses are firmly fastened.
- ◆ Do not invert supply and return hoses (return hose blue or with blue marking, supply hose black).
- ◆ Separate supply and return hoses from fuel tank.



Note

After installing the Fuel level indicator sensor -G-, check whether supply and return tubes and vent tubes are still fastened on fuel tank.

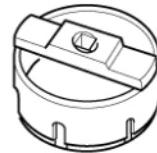
1.6 Fuel level indicator sensor -G-

Special tools and workshop equipment required



- ◆ Spanner -VW 5321/9- or Spanner -T10334-

VW 5321/9



Q00-0016

- ◆ Torque wrench - 40 to 200 Nm (enc. 1/2") -VAG 1332-

V.A.G 1332



W00-0428

1.6.1 Removal

Follow safety measures [⇒ page 89](#).

Follow cleaning rules [⇒ page 89](#).

- First, check if a code radio equipment is installed. If this is the case, request the anti-theft code.
- With the ignition switched off, disconnect the Battery -A- earth strap.
- Fold rear seat forwards.
- Remove the access cover of the Fuel level indicator sensor - G- and remove 2-pole connection from flange.
- Disengage 2-pole connector, as well as supply and return tubes from the Fuel level indicator sensor -G- .



WARNING

- ◆ Both the fuel and the fuel tubes may become very hot (risk of burns)!
- ◆ In addition, the fuel system is under pressure! Before opening the system, place a clean cloth on the fitting and relieve the pressure by carefully loosening it!
- ◆ Always use goggles and gloves in all the installation works in the fuel system!



Note

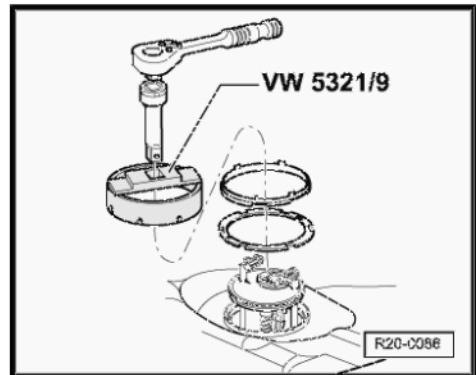
To do so, press the buttons on the tube couplings.



- Release the Fuel level indicator sensor -G- with Wrench -VW 5321/9 - or Wrench -T10334- .
- Remove the Fuel level indicator sensor -G- through the fuel tank opening.

**Note**

If the Fuel level indicator sensor -G- is to be replaced, the old Fuel level indicator sensor -G- must be cleaned before disposal.

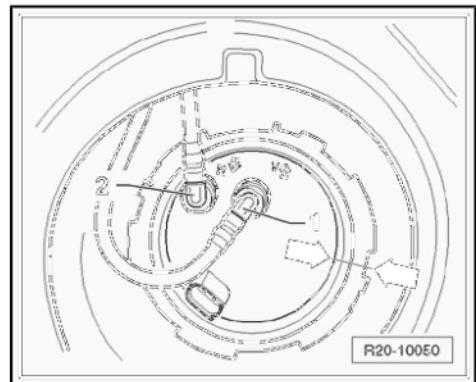


1.6.2 Installation

- The installation of the Fuel level indicator sensor -G- is carried out in the reverse removal order.

**Note**

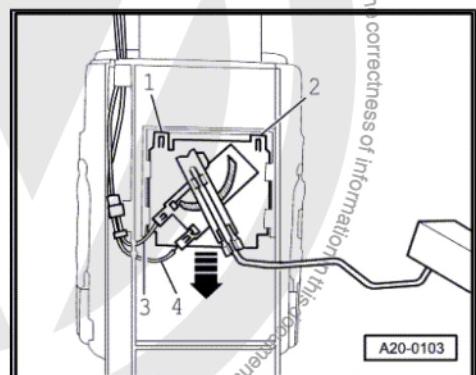
- ◆ *Do not bend the fuel level sensor.*
- ◆ *The sealing ring on the Fuel level indicator sensor -G- must be installed dry through the fuel tank opening.*
- ◆ *Moisten the sealing ring with fuel only to install the Fuel level indicator sensor -G-.*
- ◆ *Make sure that fuel hoses are firmly fastened.*
- ◆ *After installing the Fuel level indicator sensor -G- , check whether supply and return tubes and vent tubes are still fastened on fuel tank.*
- ◆ *Installation arrangement of the Fuel level indicator sensor -G-. The -arrow- stamped on the flange must match the mark on the fuel tank -arrows-.*



1.7 Fuel level meter - remove and install

1.7.1 Removal

- Remove Fuel level indicator sensor -G- [page 91](#) .
- Disconnect cables -3- and -4- .
- Raise fastening locks -1- and -2- with a screwdriver and remove the fuel level sensor -arrow-.



1.7.2 Installation

- Insert the fuel level meter in the guides and press upwards until fitting.



1.8 Engine power electronic adjustment (electronic accelerator): check

1 - Pedal support

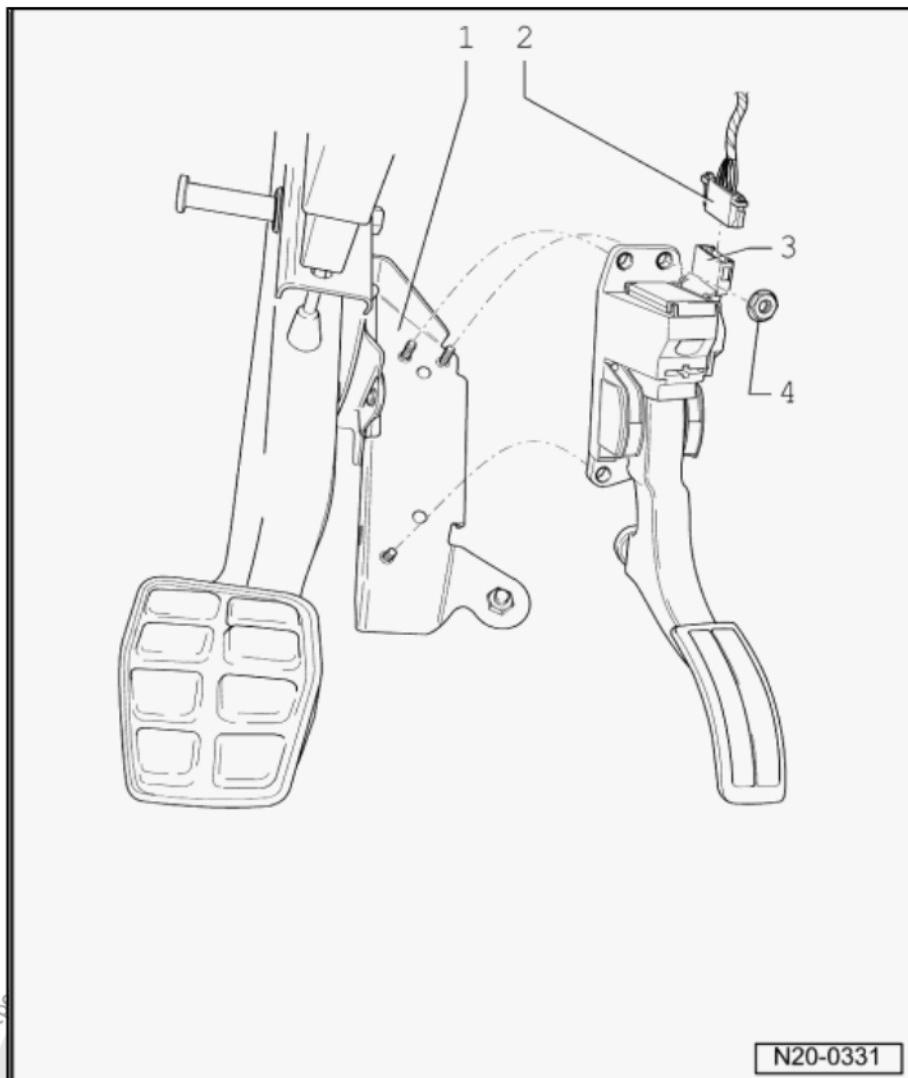
2 - Connector

- Black, 6 poles.

3 - Accelerator pedal position sensor -G79-

- The Accelerator pedal position sensor -G79- transmits the driver's intention to the Engine control unit -J623- .

4 - 10 Nm





23 – Supply system - mechanical injection (diesel)

1 Direct diesel injection system - repair

The Engine control unit -J623- is equipped with fault memory. Before or after performing repairs or adjusting works, refer to the fault memory [⇒ page 107](#).

Safety measures [⇒ page 95](#).

Cleaning rules [⇒ page 89](#).

1.1 Safety measures



WARNING

For installation works, especially in the engine compartment, due to reduced existing space, consider the following:

- ◆ All hoses (e.g. fuel, hydraulics, activated charcoal filter system, cooling system and cooling gas, brake fluid, vacuum) and electric cables must be restored to their original positions.
- ◆ Provide easy access to all the moving or hot parts.

To prevent personal injuries and/or injection and pre-heating equipment destruction, observe the following items:

- ◆ Disconnect and connect cables and wires in the injection and pre-heating system, as well as the cables of metering equipment, always with the ignition OFF.
- ◆ When the engine must run at starter speed, without actually starting it, for example, in the compression test, disengage the 10-pole connector from the injector pump.
- ◆ Before disconnecting Battery -A- from coded radios, request the anti-theft code.
- ◆ Battery -A- disconnection and connection must only be made with ignition OFF; otherwise, the Engine control unit -J623- may be damaged.

When during a test run, it is necessary to use testing and metering equipment, observe the precautions below:

- ◆ Testing and metering equipment must be secured on backseat and handled there by a second person.

When testing or metering equipment are handled on the front passenger seat, and in case of accident, this may cause injuries to the passenger due to airbag activation.

1.2 Cleaning rules

For jobs on the fuel / injection system, strictly observe the following "6 cleaning" rules:

- ◆ Clean thoroughly the connections and surrounding areas before disconnecting them.
- ◆ Place parts on clean surface and cover them. Do not use cloth that releases lint!
- ◆ If repair works are not to be carried out immediately, opened components must be covered up or carefully preserved.
- ◆ Install clean components only. Remove spare parts from packaging only before installing them. Do not install components



that have been kept out of packaging (i.e. inside the tool box, etc.).

- ◆ With system open: If possible, avoid using compressed air. If possible, do not move the vehicle.
- ◆ Take care to prevent diesel fuel from contacting the cooling system hoses. Occasionally, the hoses must be immediately cleaned. Damaged hoses must be changed.

1.3 Injector pump - repair

- ◆ Follow cleaning rules [⇒ page 89](#).
- ◆ Remove and install injector pump [⇒ page 99](#).
- ◆ Check and test dynamically the injection start [⇒ page 108](#).
- ◆ Always change the sealing rings.

1 - 25 Nm

2 - Injector pump gear

- Remove and install
[⇒ page 99](#).

3 - Fastening nut

- For hub.
- Under no circumstances should be loosened. Otherwise, the basic adjustment of the injector pump will be impaired and it cannot be adjusted with the normal resources at a workshop.

4 - Flange, 25 Nm

- For supply tube.

5 - Sealing ring

- Replace.

6 - Fuel cutoff valve -N109-,
40 Nm

7 - Coupling nozzle

- For return tube.

8 - Return hose

- To regulating valve/fuel filter.

9 - 25 Nm

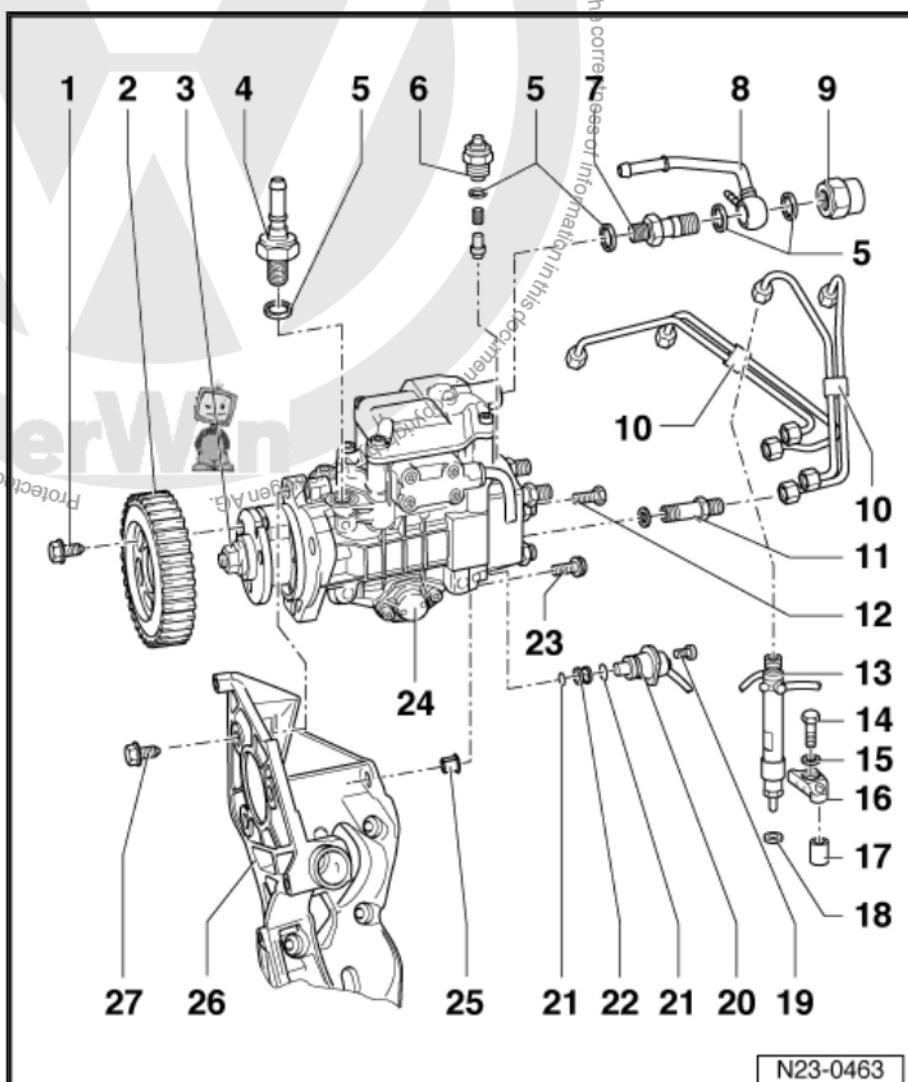
10 - Injection tubing

- Tighten to 25 Nm.
- Remove with Open star wrench -3035-.
- Always remove the complete tube set.
- Do not change curvature.

11 - Flange, 45 Nm

- With pressure valve.

12 - 25 Nm





13 - Injector

- For cylinder 3 with needle travel sensor.
- Remove and install [page 103](#).
- Check [page 105](#).

14 - 20 Nm

15 - Washer

16 - Bearing

17 - Spacer sleeve

18 - Thermal protection sealing

- Replace.

19 - 10 Nm

20 - Valve for injection start -N108-

21 - Sealing ring

- Replace.

22 - Screen filter

23 - 30 Nm

24 - Injection regulator case cover

- In case of leakage, change the sealing ring [page 106](#).

25 - Sleeve

- With nut.

26 - Compact support

- Remove and install [page 11](#).

27 - 30 Nm





1.4 Intake manifold - remove and install

1 - 25 Nm

2 - 10 Nm

3 - Clamp

4 - Sealing ring

Replace.

5 - Intake manifold valve motor
-V157-

6 - 10 Nm

7 - Housing vent fitting

8 - 20 Nm

9 - Gasket

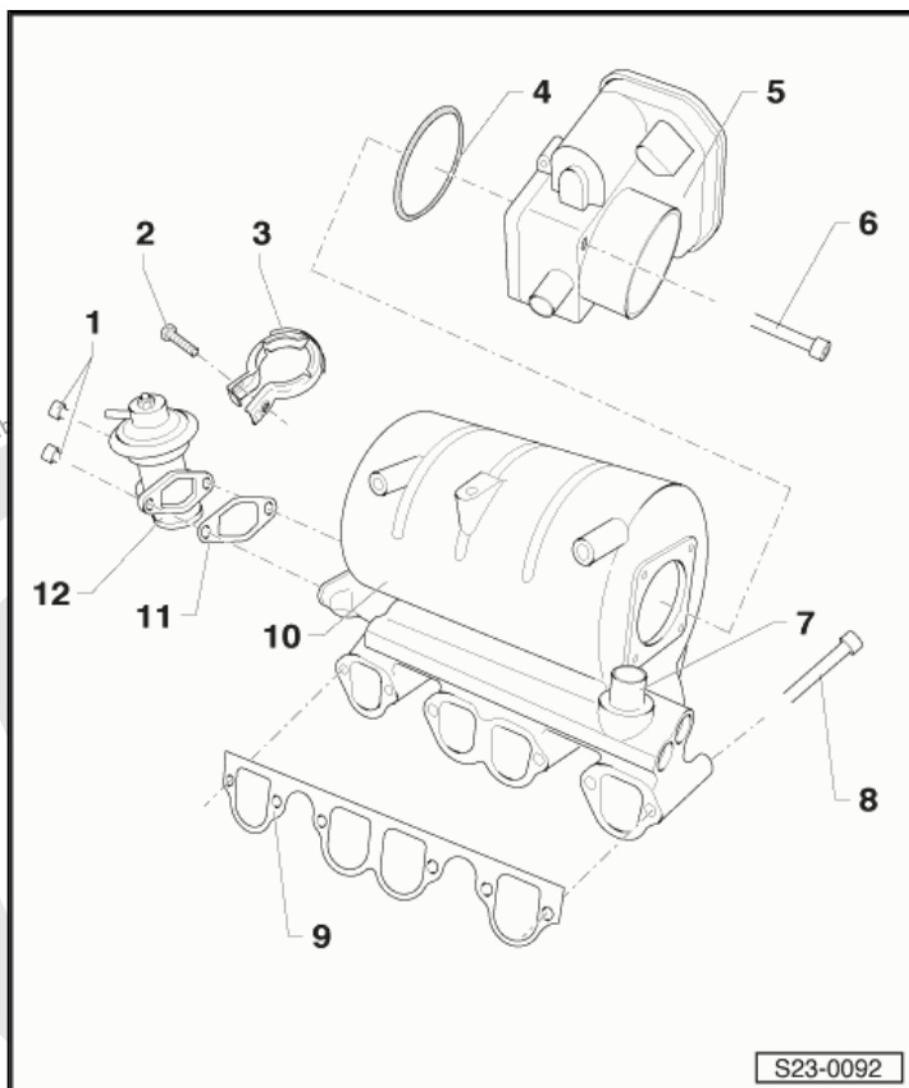
Replace.

10 - Intake manifold

11 - Gasket

Replace

12 - Exhaust gas return valve

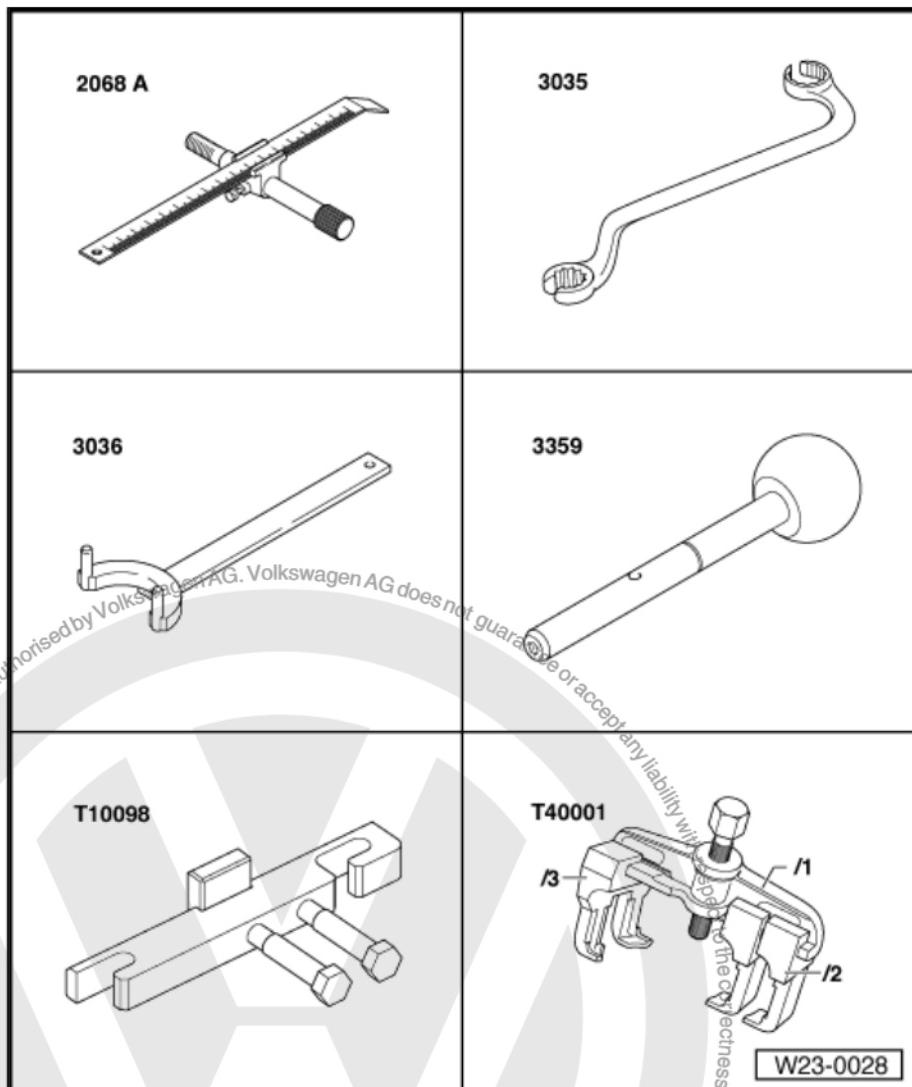




1.5 Injector pump - remove and install

Special tools and workshop equipment required

- ◆ Top dead centre adjustment device -2068 A-
- ◆ Open star wrench -3035 -
- ◆ Special wrench -3036-
- ◆ Lock pin -3359-
- ◆ Alignment bar -T 10098A-
- ◆ Puller -T 40001-
- ◆ Adapter -V.A.G 1318/10-

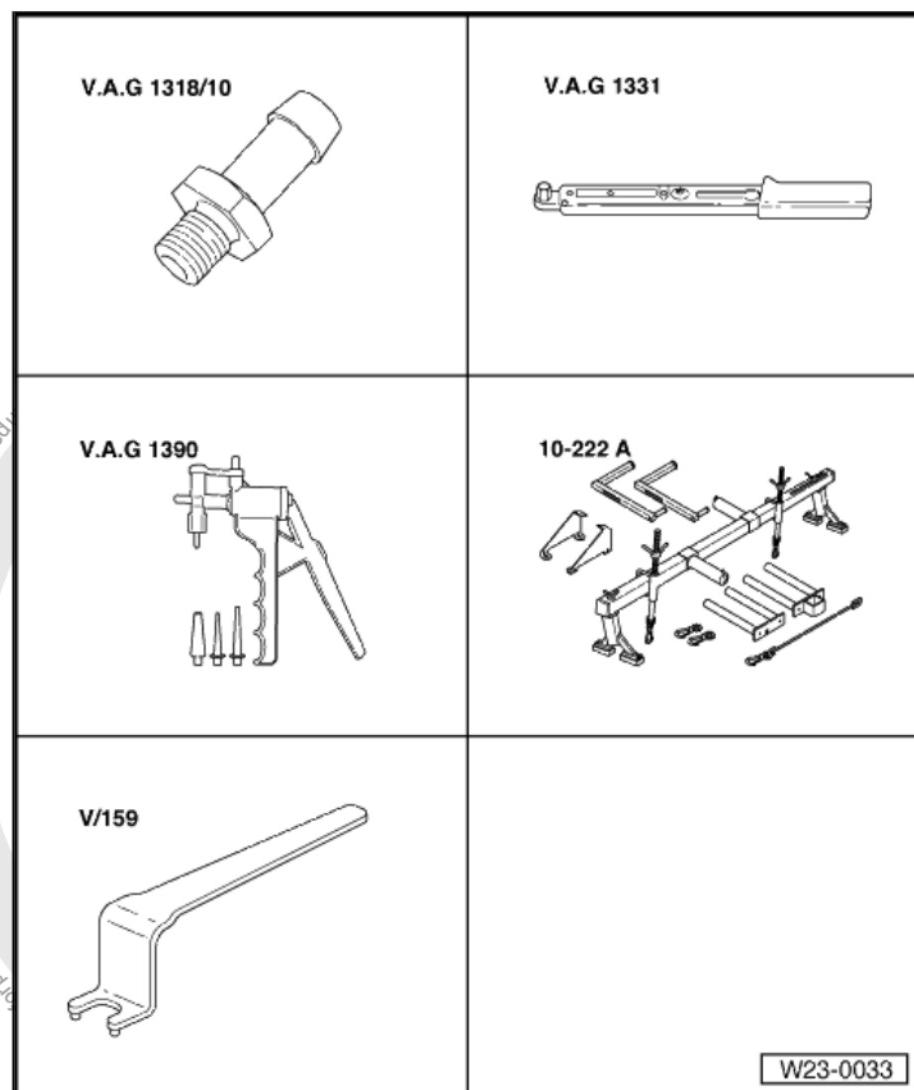


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- ◆ Torque wrench - 5 to 50Nm (enc. 1/2") -VAG 1331-
- ◆ Vacuum pump -VAG 1390 (VWB) - ou - VAS 6213-
- ◆ Suporte or VW 061 -10-222A- with feet -10 - 222A/1-
- ◆ Wrench -V 159-



1.5.1 Removal

- Remove the toothed belt [⇒ page 36](#).



Note

The belt pulley/vibration damper, as well as the lower part of the toothed belt, may remain installed.

- Release all the fuel hoses from pump.

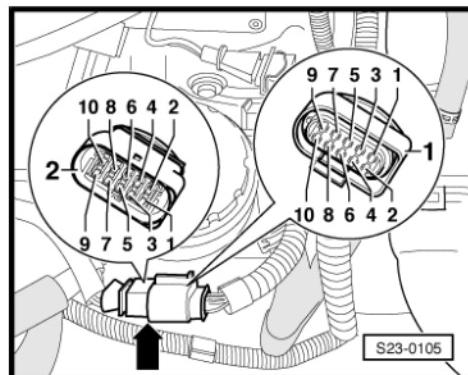


Note

- ◆ To remove injection tubing, use Open star wrench -3035- .
 - ◆ Do not change curvature.
- Cover openings with a clean cloth.



- Disengage the 10-pole connection to injector pump and remove the support connector.

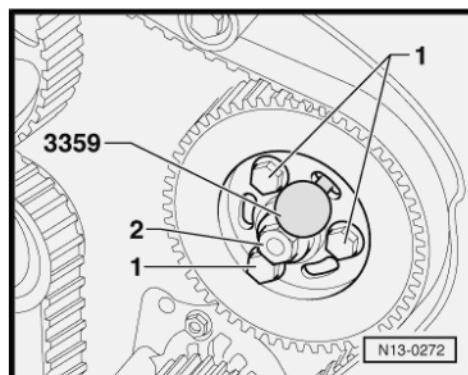


- Remove fastening screws -1- of the injector pump gear.

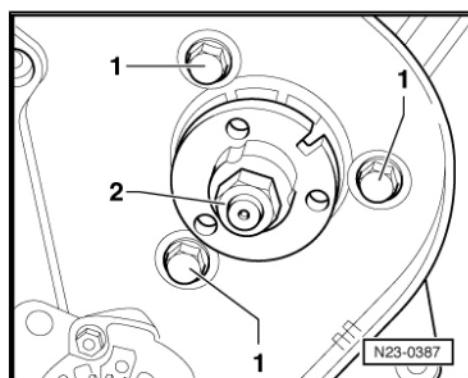


Note

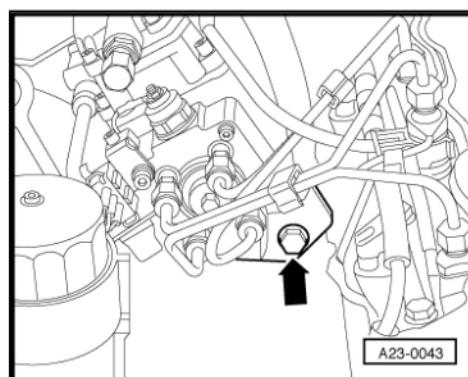
The nut -2- of the hub should not be loosened under any circumstances. Otherwise, the basic adjustment of the injector pump will be impaired and it cannot be adjusted with the normal resources at a workshop.



- Remove the fastening screws-1- from the compact support.



- Then, remove the fastening screw -arrow- from the rear support.
- Remove the injector pump.

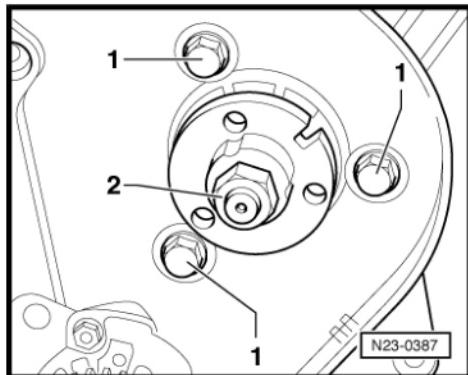


1.5.2 Installation

- Install the injector pump on the compact support and first fasten it to the rear support with the fastening nut.



- Install fastening screws -1- and tighten to 30 Nm.

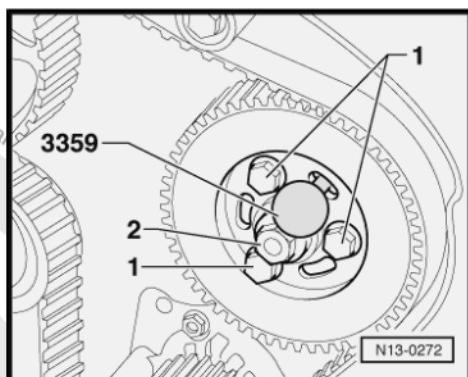


- Do not tighten the injector pump gear with fastening screws -1- in the hub.
- Immobilise the injector pump gear with Locking pin -3359-
- Align the injector pump gear in the centre position in the elongated holes.
- Loosen the camshaft gear fastening screw by one turn. To loosen the fastening screw, immobilise the camshaft gear with the Special wrench -3036- .

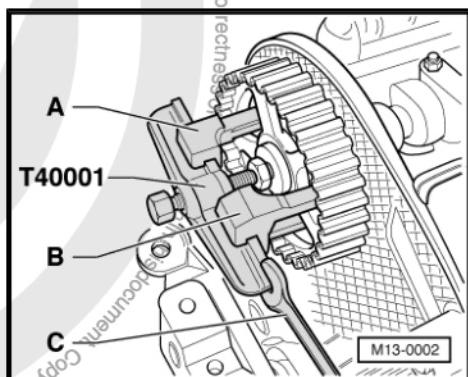


Note

To loosen and tighten the camshaft gear, never use the Alignment bar -T 1009&A- ! Use the Special wrench -3036- .



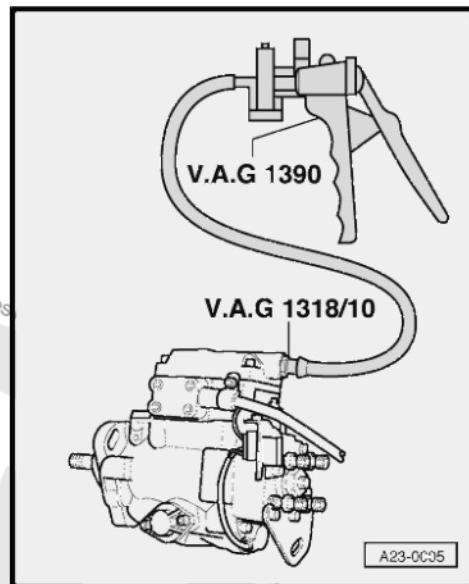
- Place Puller -T 40001- with Single arm claw -T40001/2- -A- and 2-arm claw -T40001/3- -B- centred on the camshaft gear, and extract. In this procedure, use a fixed wrench-C- as supporting element.
- Remove camshaft gear.
- Check that TDC marking on the flywheel matches the reference mark.
- Install the toothed belt on the injector pump gear and tensioning pulley.
- Install the camshaft gear in the toothed belt and fasten the gear in order that the camshaft may be still turned.
- Adjust the toothed belt [⇒ page 36](#).
- Connect injection tubing, fuel supply hose and all the electrical connections.





Fill the injector pump with fuel, as follows.

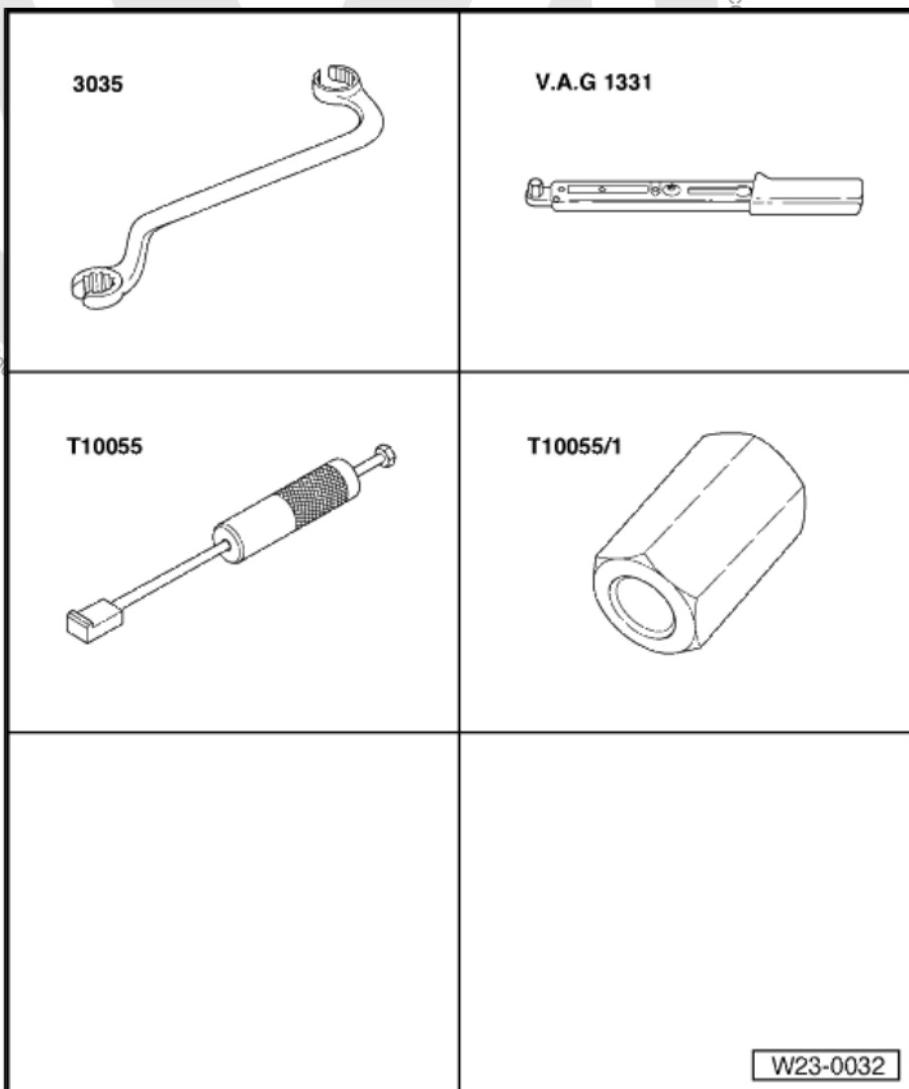
- Install Adapter -V.A.G 1318/10- through the return opening of injector pump.
- Connect Vacuum pump -VAG 1390 (VWB) - ou - VAS 6213- with approx. 1m of transparent plastic hose in the adapter.
- Activate Vacuum pump -VAG 1390 (VWB) - ou - VAS 6213- until the fuel flows out of the return opening. Do not aspirate fuel to the Vacuum pump -VAG 1390 (VWB) - ou - VAS 6213- .
- Remove Adapter -V.A.G 1318/10- and connect the fuel return hose.
- Check dynamically the injection start, and occasionally adjust [⇒ page 108](#).



1.6 Injectors - remove and install

Special tools and workshop equipment required

- ◆ Star wrench -3035-
- ◆ Torque wrench -5 to 50Nm (enc. 1/2") -VAG1331-
- ◆ Puller -T 10055-
- ◆ Adapter -T 10055/1-





Note

- ◆ Defective injectors cause the problems below:
- ◆ Ignition faults
- ◆ "Metallic" knocks in one or more pistons
- ◆ Engine overheating
- ◆ Efficiency reduction
- ◆ Excess black smoke from the exhaust tube
- ◆ High fuel consumption
- ◆ Excess blue smoke upon cold start

Defective injectors may be identified by loosening sequentially the injection duct cap nuts, with the engine running at idle speed. If the engine speed remains constant after loosening a cap nut, this indicates a defective injector.

1.6.1 Removal

- Remove injection tubing with the Open star wrench -3035- .



Note

Always remove the complete tubing set; do not change the curvature.

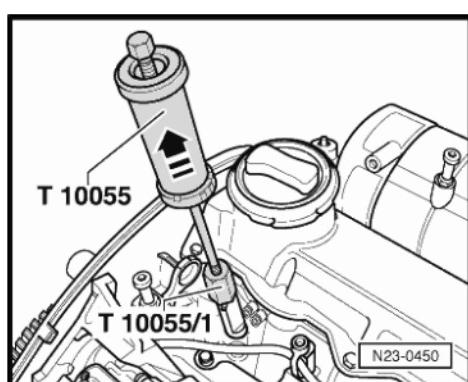
- Loosen the fastening screw, remove locking bearing and remove injector.



Note

To extract locked injectors, use Puller T 10055- with Adapter T 10055/1- .

- Install the Puller -T 10055- with Adapter -T 10055/1- on the injector.
- Remove the injector by slightly tapping towards -arrow-, and removing it from the housing in the cylinder head.



1.6.2 Installation



Note

Always change the thermal gaskets between the cylinder head and injectors.

- Install injectors.



- Pay attention to the correct seating of the cylinder head fastening bearings.
- Install locking handle.

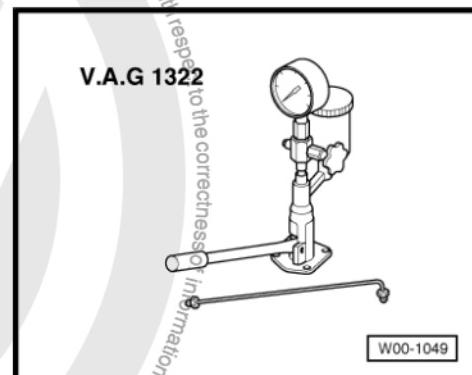
Tightening torques: Injection tubing = 25 Nm, Locking bearing screw = 20 Nm.

1.7 Injectors - check

These engines are equipped with 2-spring injectors. Due to this reason, the fuel injection occurs in 2 stages. In case of complaint about these injectors, only the replacement can be done, because neither pressure adjustment nor repair are possible.

Special tools and workshop equipment required

- ◆ Injector nozzle test equipment -VAG 1322- with Pressure duct -V.A.G 1322/2-



1.7.1 Checking conditions

- Pressure gauge connected

1.7.2 Check injection pressure

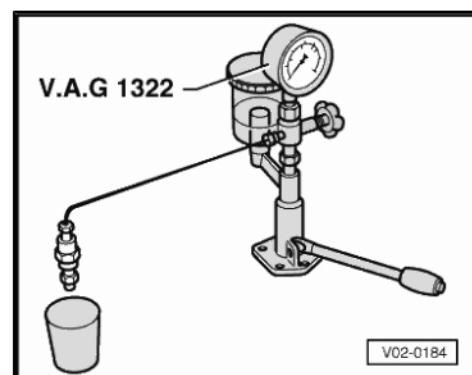


WARNING

Upon injector test, pay attention to the fuel spray in order that it does not fall on the hands, because the high pressure of the fuel may penetrate the skin and cause severe injuries.

- Remove injector [page 103](#).
- Install the injector in the Injector nozzle test equipment -VAG 1322- .
- Press the lever on the Injector nozzle test equipment -VAG 1322- downwards. When starting the injection, read the injection pressure. If it deviates from the nominal value, replace the injector.

Theoretical values: new injector pressure: 220... 230 bar. Wear limit: 190 bar.



1.7.3 Check tightness

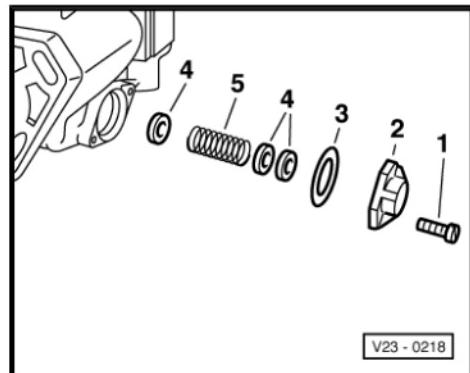
- Press the lever on the Injector nozzle test equipment -VAG 1322- slowly downwards and keep pressure during 10 seconds at approx. 150 bar. No fuel leakage must occur by the injector opening.



- In case of leakage, replace the injector.

1.8 Sealing ring on the injection regulator cover - replace

- Place a clean cloth under the injector pump.
- Remove the screws from the cover -1- with a normal Torx angular wrench for screws -Torx-, e.g. Hazet 2115-T30.
- Remove the cover -2- and clean.
- Replace the sealing ring -3- and install the cover with the existing compensating discs -4- .





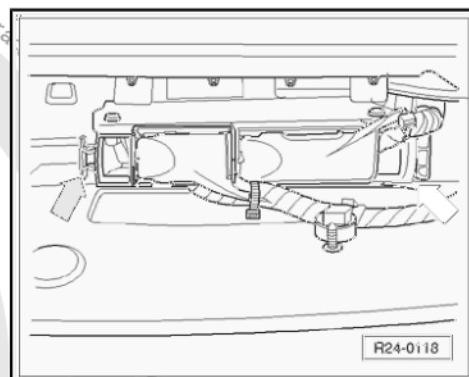
2 Engine control unit -J623-

2.1 Engine control unit -J623- - remove and install

- Before removing the Engine control unit -J623- the identification- of the Engine control unit -J623- , as well as the Engine control unit -J623- coding used to this date shall be selected [⇒ page 107](#) .

2.1.1 Removal

- Turn the ignition off.
- Remove the windscreen wiper arms and respective blades and the lower lining of the windscreen frame.
- Disengage the connectors in the Engine control unit -J623- by pulling them outwards-arrows-.
- Slide the Engine control unit -J623- to remove it from the support rails.



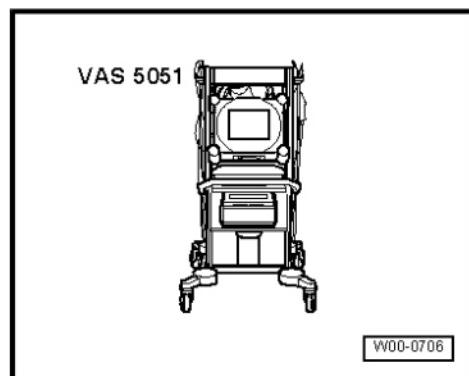
2.1.2 Installation

- Insert the new Engine control unit - J623- .
- Install the connectors by pressing them laterally.
- Install the windscreen wiper arms and respective blades and the lower lining of the windscreen frame.
- Check the coding being used and code the new Engine control unit -J623- [⇒ page 108](#) .

2.2 Engine control unit -J623- fault memory - read and clear

Special tools and workshop equipment required

- ◆ Diagnosis, Measurement and Information System -VAS 5051A/52-



- ◆ Diagnosis cable -VAS 5051/1- or Diagnosis cable -VAS 5051/3-

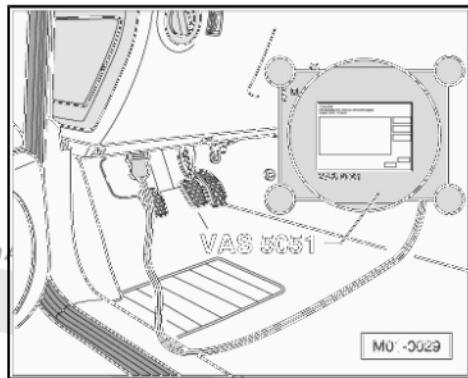


2.2.1 Sequence of operations

- Connect the Vehicle Diagnosis, Measurement and Information System -VAS 5051A/52- as follows:
- Insert the Diagnostic cable -VAS 5051/1- or Diagnostic cable -VAS 5051/3- socket in the diagnostic connection.
- Start the engine and leave it at idling speed.

Only if the engine does not start:

- Turn the ignition on.



2.2.2 Select operating mode:

- On the display, press the surface for "vehicle self-diagnosis".

2.2.3 Select the vehicle system:

- On the display, press the surface for "01 engine electronics".

The display shows the Engine control unit -J623- identification and code.

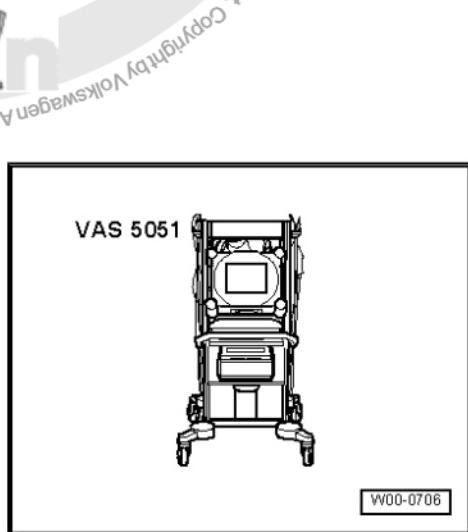
2.2.4 Select diagnosis function:

- On the display, press the surface for "02 - select fault memory".
- If no fault was saved in the Engine control unit -J623-, the display will show "0 no fault identified".
- If faults were saved in the Engine control unit -J623-, these are shown sequentially, on the display.
- Press the ? key.
- On the display, press the surface for "05 clear fault memory".
- Press the function "06 end section".

2.3 Functions and components - adapt

Special tools and workshop equipment required

- ◆ Diagnosis, Measurement and Information System -VAS 5051A/52-



- ◆ Diagnosis cable -VAS 5051/1- or Diagnosis cable -VAS 5051/3-

Select the function "assisted troubleshooting" in the Vehicle Diagnosis, Measurement and Information System -VAS 5051A/52-



After all control instruments have been inquired:

- Press the "Sprung" or "Skip" button
- Select "function/component selection"
- "Select propulsion"
- Select "Engine identification letters".
- Select "01 - Systems with Self-diagnosis"
- Select "Engine control"
- Select "Functions"
- Select "Functions or components"



26 – Exhaust system

1 Removing and installing exhaust system parts

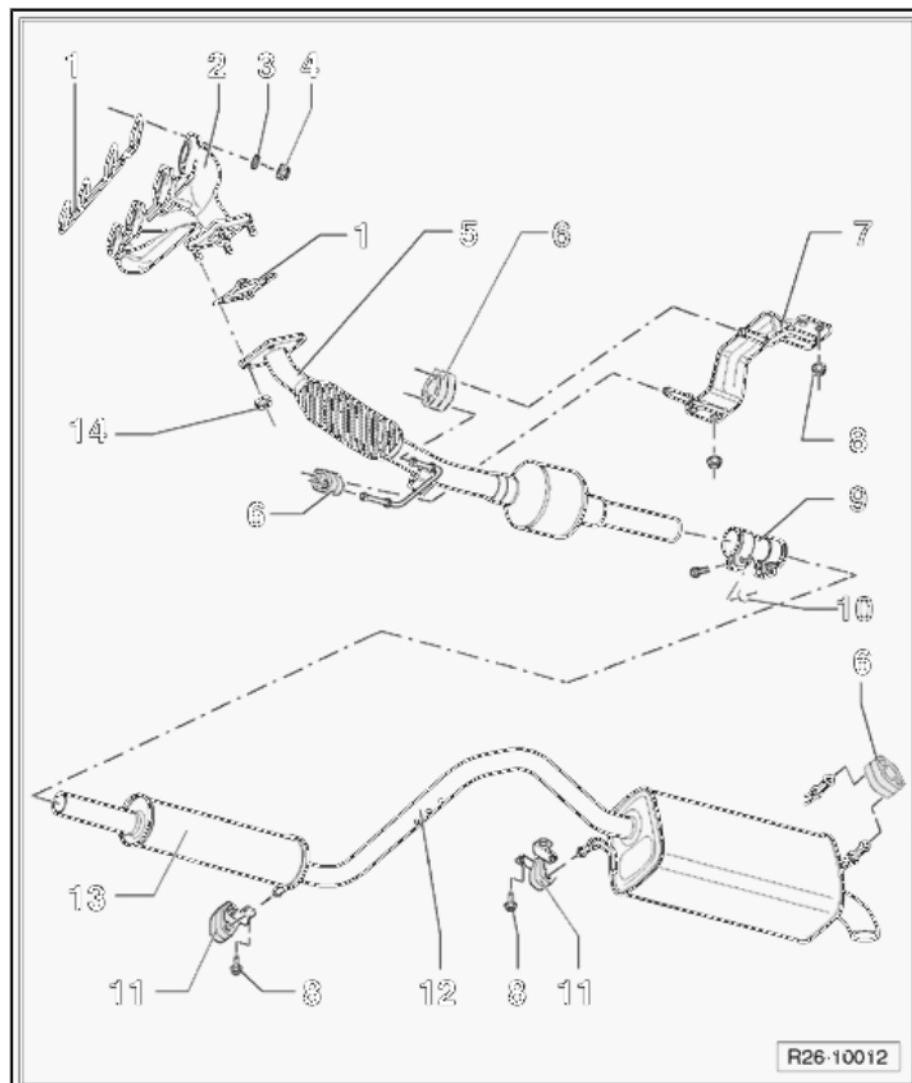


Note

- ◆ After performing works on the exhaust system, make sure the system is not stressed and provides enough distance from the body. If necessary, loosen the double clamp(s) and align the muffler and exhaust tube in order to provide enough space from the body throughout the path and to demand equally the supporting bearings/grommets.
 - ◆ Always replace self-locking nuts.

1.1 Exhaust system - remove and install

- 1 - Gasket
 - Replace.
 - 2 - Exhaust manifold
 - With connection for exhaust gas return
 - 3 - Washer
 - 4 - Self-locking nut
 - 25 Nm
 - Replace after each removal.
 - Lubricate thread with High temperature paste -G 052 112 A3- .
 - 5 - Front exhaust tube with catalytic converter
 - 6 - Supporting bearing
 - Replace if damaged.
 - 7 - Support
 - 8 - 23 Nm
 - 9 - Double clamp
 - Observe installation position **page 111**
 - 10 - Self-locking nut
 - 40 Nm
 - Replace after each removal.
 - 11 - Supporting bearing
 - Observe installation position **page 111**
 - Replace if damaged.
 - 12 - Separation point
 - In case of repair.



...information in this document or any liability with respect



- Characterised by three engravings on the diameter of the exhaust tube.
- In series mounting, the intermediate and rear mufflers are mounted as a single part. In case of repair, the intermediate and rear mufflers are supplied separately with a double clamp for repair.
- Separate the exhausting tube at the separation place with saw for body repairs, e.g. Pneumatic Saw or EQ 7415 -VAG 1523A- or Tube cutter -VAS 6254- in right angle [⇒ page 111](#)

13 - Intermediate muffler

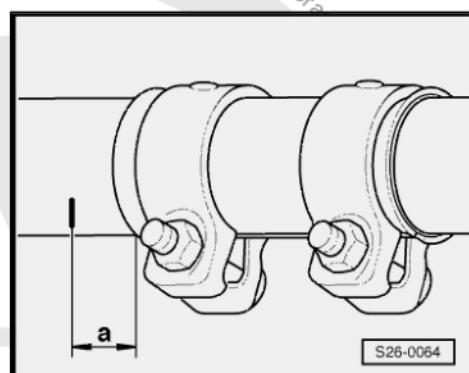
- In case of repair, replace individually [⇒ page 111](#)
- Observe installation position [⇒ page 111](#)

14 - Self-locking nut

- 40 Nm
- Replace after each removal.
- Lubricate thread with High temperature paste - G 052 112 A3- .

Installation position for the double clamp

- The distance -a- between the double clamp and marking shall be approx. 5 mm.



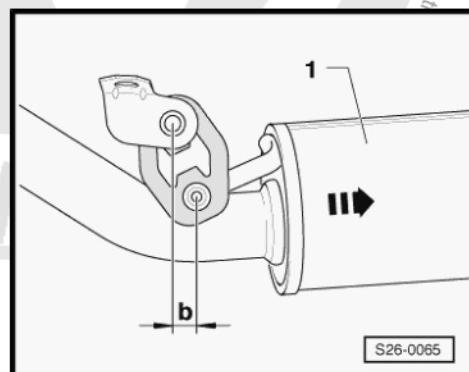
1.1.1 Prerequisite

- The exhaust system must be cold.

1.1.2 Sequence of operations

Support installation arrangement

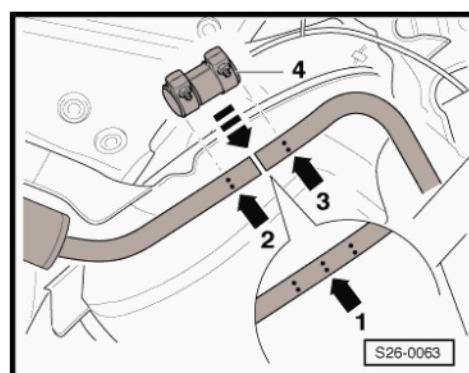
The -arrow- indicates the front of the vehicle.



1.1.3 Sequence of operations

- Install front muffler -1- so the measure -b- is 3...7 mm.

Separation place on the exhaust tube





Special tools and workshop equipment required

- ◆ Pneumatic Saw -VAG 1523A- or Tube cutter -VAS 6254-

1.1.4 Sequence of operations

- Cut the tube perpendicularly at the cutting point -arrow- -1-.
- Position the double clamp for repairs -4- on the assembly, at side marks -arrows 2 and 3-. Tightening torque 40 Nm.





2 Exhaust gas return system

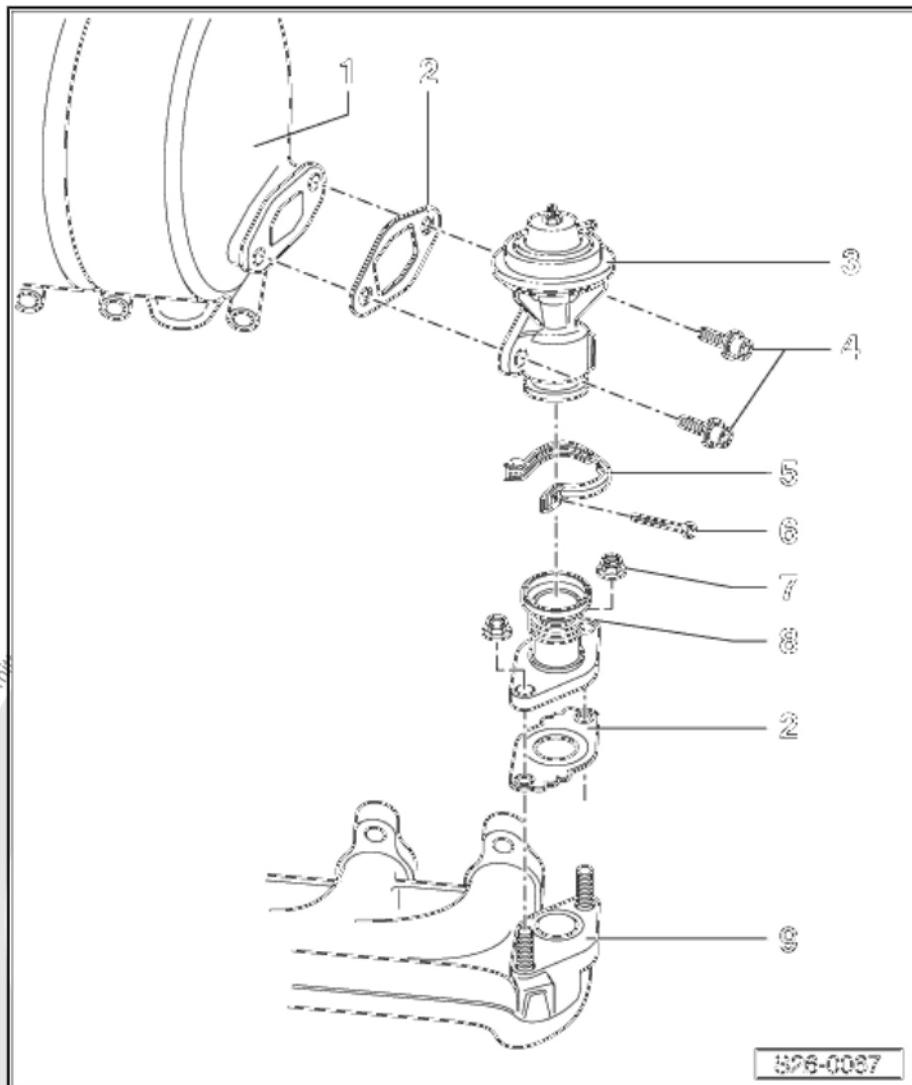


Note

- ◆ The selection of the exhaust gas return system is made via Engine control unit -J623- with the Valve for exhaust gas recirculation -N18-.
- ◆ The mechanical valve for exhaust gas return with tapered valve stem enables several opening cross cuts in the travel of different valves.
- ◆ Any position of the valve is enabled by a paced selection.
- ◆ Always replace self-locking nuts.

2.1 Exhaust return system components - remove and install

- 1 - Intake manifold
- 2 - Gasket
- Replace.
- 3 - Exhaust gas return valve
- Check [page 114](#).
- 4 - 25 Nm
- 5 - Clamp
- 6 - 10 Nm
- 7 - 20 Nm
- Replace.
- 8 - Connecting tube
- 9 - Exhaust manifold





2.2 Connection plan for vacuum hoses

1 - Exhaust gas return valve

2 - Exhaust gas recirculation valve -N18-

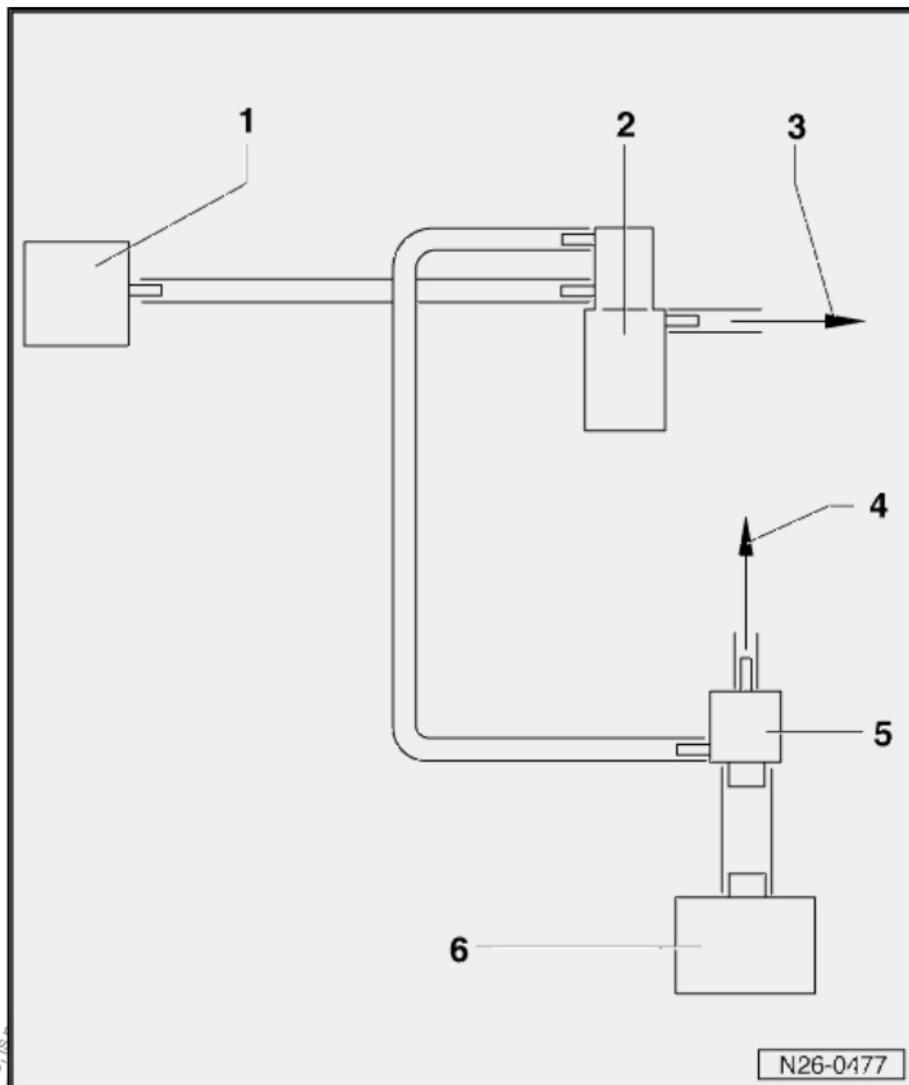
3 - Up to the air filter

4 - To servo brake

5 - Check valve

Observe installation position

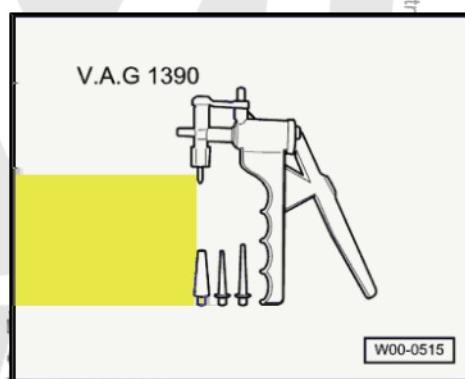
6 - Vacuum pump



2.3 Check exhaust gas return valve

Special tools and workshop equipment required

- ◆ Vacuum pump -VAG 1390 (VWB) - ou - VAS 6213-

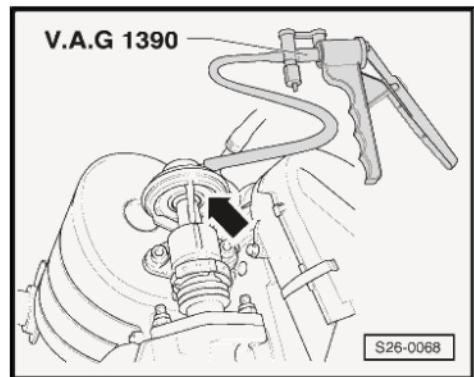


2.3.1 Checking sequence

- Disconnect the vacuum tube of the exhaust gas return system.



- Connect Vacuum pump -VAG 1390 (VWB) - ou - VAS 6213- to vacuum tube.
- Activate Vacuum pump -VAG 1390 (VWB) - ou - VAS 6213-. The membrane must move towards vacuum connection (Check direction under).
- Disconnect vacuum pump hose from the exhaust gas return valve. Valve closing is clearly audible. (The membrane moves towards exhaust gas elbow.)





28 – Chamber pre-heating system

1 Chamber pre-heating system - check

Special tools and workshop equipment required

- ◆ Portable multimeter -VAG 1526C-
- ◆ Auxiliary measuring cable set -VAG 1594C-

Checking conditions

- Blade fuse 178 for pre-heating plugs on the fuse holder / Battery -A- OK.
- The Battery -A- voltage must be at least 11.5 V.
- All power consuming components, like lights and rear window demister, must be off.
- Engine control unit -J623- OK.

Checking sequence

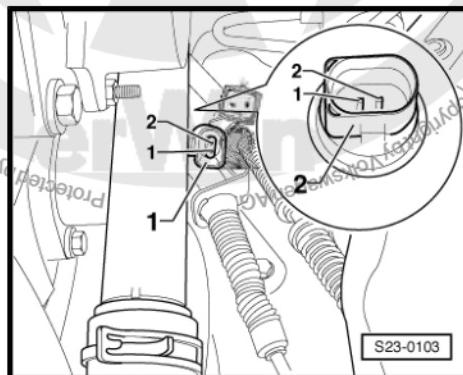
- Remove 2-pole connector -1- from the Coolant temperature sensor -G62- -2-.



Note

By disengaging the Coolant temperature sensor -G62- connector, a "very cold engine" situation is simulated and when the ignition is started, the corresponding pre-heating process is performed.

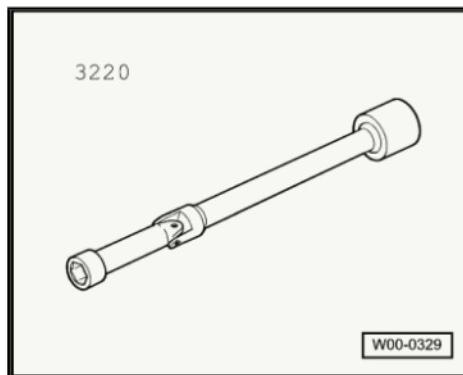
- Disengage pre-heating plug connector.
- Connect the multimeter for measuring the voltage between the plug terminal and earth.
- Start the ignition during approx. 20 seconds. The approximate value of the Battery -A- voltage shall be indicated.
- If there is no voltage:
- Refer to fault memory, fix eventual faults and clear fault memory [⇒ page 107](#).



1.1 Pre-heating plugs - check

Special tools and workshop equipment required

- ◆ U/J extension and socket, 10 mm -3220-



- ◆ Auxiliary measuring cable set -VAG 1594C-
- ◆ Test probe -VAG 1527B-



1.1.1 Checking conditions

- Blade fuse 178 for pre-heating plugs on the fuse holder / Battery -A- OK.
- The Battery -A- voltage must be at least 11.5 V.
- All power consuming components, like lights and rear window demister, must be off.

1.1.2 Checking sequence

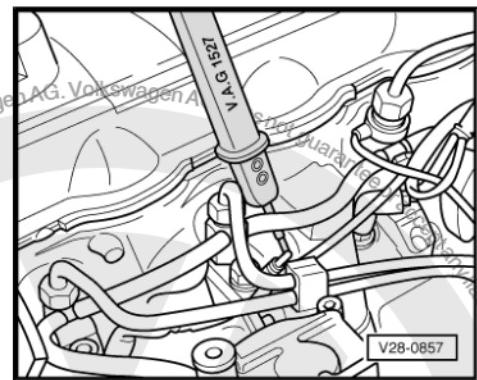
- Disengage plug connector.
- Connect Test probe -VAG 1527B- with the Auxiliary measuring cable set -VAG 1594C- in the positive (+) terminal of Battery -A- .
- Place the Test probe -VAG 1527B- sequentially on each plug.

The LED lights up: plug OK

The LED does not light up: replace the plug.

- Remove and install the pre-heating plugs, using U/J extension and socket, 10 mm -3220-. Tightening torque: 15 Nm.

08.10



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